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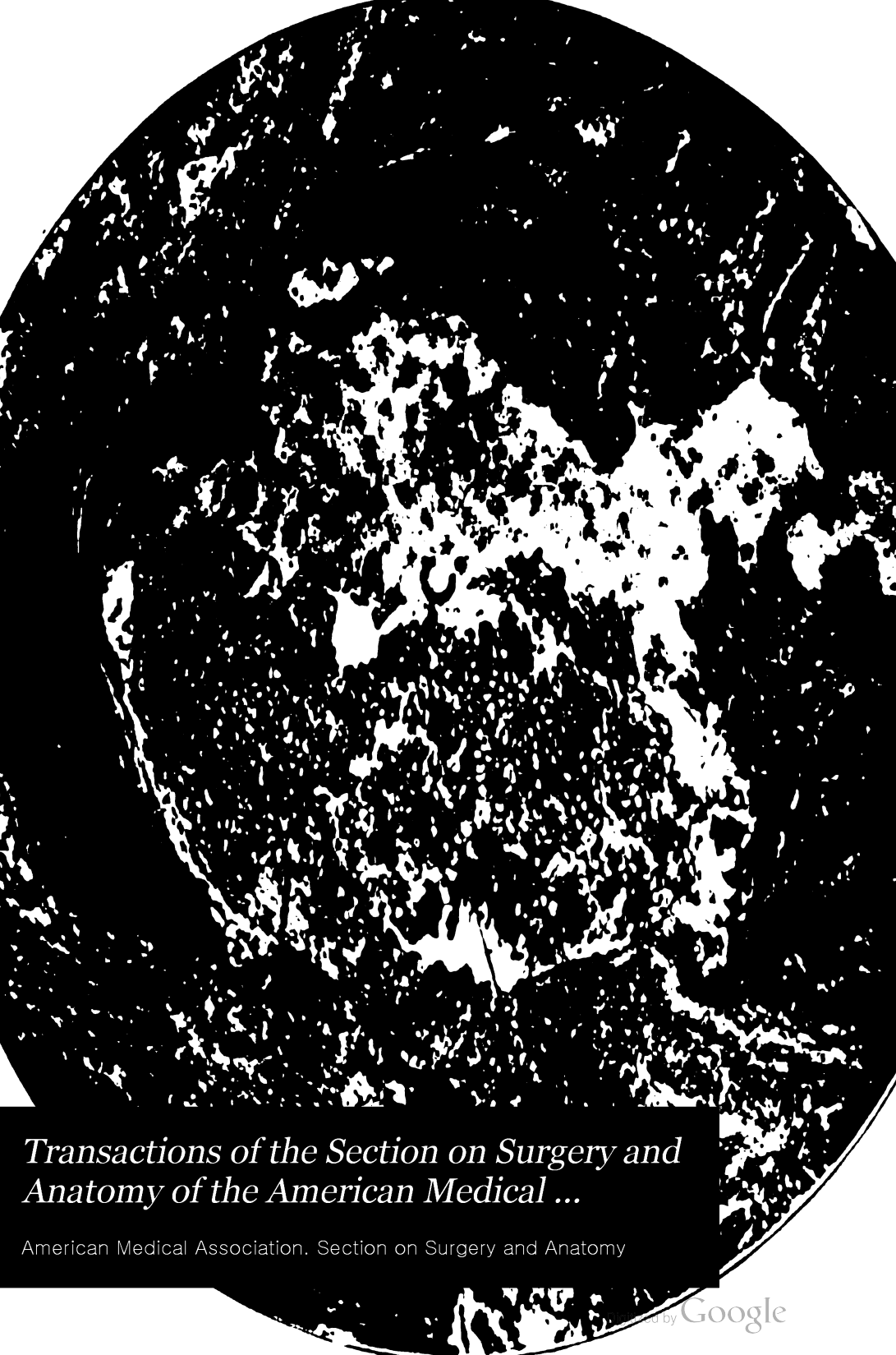

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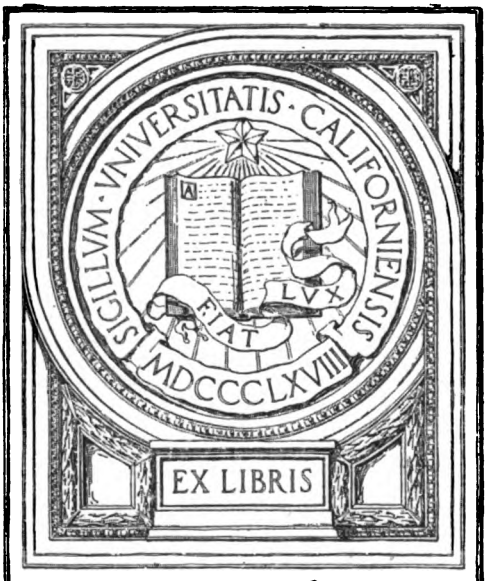

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TRANSACTIONS OF THE

SECTION ON SURGERY AND ANATOMY

of the
American Medical Association
at the Fifty-fourth Annual
Session, held at New Orleans,
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A PLEA FOR EXPLORATORY OPERATIONS.

CHAIRMAN'S ADDRESS, DELIVERED BEFORE THE SECTION ON SURGERY AND ANATOMY AT THE FIFTY-FOURTH ANNUAL SESSION OF THE AMERICAN MEDICAL ASSOCIATION, AT NEW ORLEANS, MAY 5-8, 1903.

JAMES E. MOORE, M.D.
MINNEAPOLIS.

One duty of the Chairman of this Section, as prescribed by our by-laws, is to open the exercises with a brief comment on some surgical topic or topics of live interest.

During the past year no one subject has been of such paramount interest as to overshadow all the rest, but a steady and even rapid advancement has been made along old lines, and an exceptional amount of preliminary work or foundation laying has been done along new lines. More time and money have been expended in original research than in any previous year. The year has been made memorable by the permanent location in New York of a great laboratory for medical research, which has been placed in the hands of most eminent men, and from which we have reason to expect great results. The prevailing sentiment in the surgical world is one of wholesome conservative optimism.

Those of us who began the study of medicine before Koch made his immortal discovery of the tubercle bacillus can recall how hopelessly we endeavored to comprehend the term scrofula, that mantle of our ignorance which has happily disappeared, and how after this discovery the clouds began to disappear like snow before

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the sunshine. Have we not much greater reason, by virtue of our laboratories of research, to hope for the discovery of the cause of cancer in the near future?

Many of our medical colleges have established laboratories for the instruction of students in operations on animals, and these laboratories are being used more and more each year by practical surgeons in experimental work for the perfection of their technic and for original research. Every surgeon, no matter how much laboratory and experimental work he may have done, or how good a clinician he may be, will frequently meet cases in which conditions obtain within some one of the great cavities of the human body which are endangering the life or comfort of his patient, and which, after having exhausted all ordinary means of diagnosis, he can not diagnosticate. Under these conditions the surgeon should primarily, in the interest of his patient, and, secondarily, in his own interest, perform an exploratory operation. The mere fact that with our aseptic methods we can open the abdomen or the head with impunity gives us no license to make this a means of diagnosis until after all other methods have been exhausted. Nor does the fact that a man has learned to be reasonably certain of his asepsis entitle him to this privilege until after he is thoroughly familiar with both normal and pathologic conditions that he may find. I know of one instance, for example, in which a man opened an abdomen and was then unable to differentiate between the bladder and the sigmoid flexure, yet this patient did not die from sepsis. Such a man has no moral, and should have no legal, right to open an abdomen. This is simply an example of one of the dangers of asepsis.

This humble plea for exploratory operations is made with diffidence, for, "Fools rush in where angels fear to tread," and if this were an accepted method of diagnosis without most rigid restrictions, the ignorant and inexperienced would be the most ready to resort to it.

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Owing to the brief time allotted for the reading of this address it will be limited to exploratory abdominal operations.

The term exploratory operation in this paper means a free opening made by the knife. The aspirator and the grooved needle no longer occupy a very prominent place as a means of diagnosis among surgeons, unless it is at the bottom of a wound. It is an open question whether these instruments have done more harm or good. Even the grooved director, which at one time occupied so important a place in a surgeon's armamentarium, has fallen into "innocuous desuetude."

We should no longer be content to divide our cases into operative and non-operative until after we have exercised the same care to form an accurate diagnosis that our colleague, the internist, would, and in addition, in doubtful cases, have made an exploratory incision, for some cases which from external examination would be pronounced inoperable prove on closer inspection to be operable, and in many cases in which a radical operation can not be performed a palliative operation may add somewhat to the patient's life and save him from a great amount of suffering.

It is in the abdomen that the exploratory operation is most frequently indicated, for in this region it is comparatively free from danger, and almost invariably results in some benefit to the patient. It is very rarely, indeed, that a good surgeon will make an exploratory abdominal incision without finding some condition which can be benefited.

At the beginning of abdominal surgery, which is within the recollection of many of those present, most operations were exploratory and were made for conditions in the pelvis, but at the present time, thanks to our accumulated experience and to the fact that in this region we can make bimanual examinations with one or more fingers inside, the diagnosis can and should, as a rule, be made before operation. In a case, however,

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in which a surgeon strongly suspects an ectopic pregnancy without being able to make a positive diagnosis, it is safer to make an exploratory opening than to take the chances of a rupture. Bimanual examination through the rectum is sometimes more helpful than through the vagina, and should never be neglected in doubtful cases.

After a traumatism, when the symptoms indicate a rupture of the bladder, an exploration should be promptly made. An abdominal opening is safer and better in these cases than the injection of either air or liquids. Up to ten years ago the mortality following operations for rupture of the bladder was about 65 per cent., but since then it has dropped to 25 per cent. or less, and this is very largely due to the fact that explorations have been more promptly made. The only other prominent factor in reducing this mortality is that we have learned not to include the mucous membrane in our stitches. Occasionally we will find that a patient who is in collapse, with excruciating pain in the lower abdomen and an empty bladder, has a sound bladder but a ruptured intestine, which makes an exploratory opening even more imperative because of the septic character of the bowel contents.

Every surgeon has so much experience in the right iliac region that he usually feels quite certain of his diagnosis, yet we all meet with some cases in which we are in doubt and in which exploration should be the established rule. Few of us regret having followed this rule, and we all have had occasion to regret its neglect. There is a class of cases in which the patient complains of chronic indigestion accompanied by constipation and some pain and tenderness in the region of the appendix, in which an exploratory opening will disclose a chronically inflamed appendix, which may contain an enterolith and which may be surrounded by peritoneal adhesions, and in which the removal of the appendix will entirely relieve the symptoms. No

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experienced surgeon would hesitate to advise operation in such a case when the patient gave a history of having had an acute attack of inflammation in this region; but there are a great many such cases demanding operation in which the patient has never had an acute attack. Almost all cases of acute appendicitis, if not every case, has as a sequel a chronic appendicitis, but there are a great many cases in which the order is reversed, and the acute attack is the sequel of a chronic inflammation.

Surgery in the abdominal regions above the umbilicus is not nearly so well developed as it is below that point. Gall-bladder surgery is farther advanced than that of any other organ in this region, but even here we have much to learn. At the present time we are learning that in a good many cases drainage of the gall bladder is not sufficient, but that it must be removed. If our medical brethren will learn to refer to us for exploration their patients suffering from chronic "dyspepsia" and "gastralgia," to whom they have been giving pepsin and bismuth for years without benefit, we can demonstrate to them that most of these patients are suffering from gallstones, and that all of them have some mechanical condition which can be relieved by surgery. Until the surgery of this region is much better understood than it is now, acute epigastric peritonitis should indicate exploration, because there are so many etiologic factors here, some of which demand immediate operation and which we are as yet unable to differentiate. Diseases of the pancreas, for example, which are exciting so much interest in the surgical world, have no pathognomonic symptoms, and exploration is our only means of positive diagnosis. In acute hemorrhagic pancreatitis the patient's only hope is in early exploration, for without it the diagnosis will only be made at the postmortem.

Perforative symptoms in this or any other region, from any known or unknown cause, in civil life, demand exploration so long as the patient is not in articulo mortis.

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The consensus of opinion among surgeons who have had the most experience in surgery of the stomach is, that when malignant disease of that organ is so far advanced that a positive diagnosis can be made by ordinary means, radical operation is almost hopeless, and exploration with the view of palliative operation is scarcely worth while, because the immediate mortality about offsets the time added to human life by these operations. Chemical, clinical and all other means of early diagnosis of malignant disease of the stomach have failed us, and our only hope is in early diagnosis by exploration followed by radical operation. The most interesting point bearing on this subject at the present time is the relation between gastric ulcer and cancer. Clinicians have long maintained that in a certain percentage of cases gastric ulcer stands in a causative relation to carcinoma. That percentage has been gradually increasing until now at least one eminent authority (Fütterer) believes that all cases of carcinoma of the stomach are preceded by ulcer. If this is true, all gastric ulcers should be operated on as soon as it is demonstrated that they will not heal under medical treatment.

It is estimated that at least 65 per cent. of penetrating wounds of the abdomen are perforating. Taking this conservative estimate as a working basis we should assume that all penetrating wounds are perforating, and in civil life we should make an exploratory operation as soon as possible. To wait for symptoms of perforation means to wait for peritonitis, and this is not in keeping with modern surgery. The mortality following operation for perforating abdominal wounds is probably not over 25 per cent. in competent hands, and will be still less when the rule advocated in this paper is better understood by general practitioners. Timidity and hesitation in these cases always means loss of time, and loss of time often means loss of life. Although typhoid perforation is usually looked on as being a different proposition from perforations from other causes, it should

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be treated by the same surgical rules because perforation from this cause terminates fatally just the same as from any other cause. The fact that the patient is ill before the perforation makes operation all the more imperative. When symptoms during typhoid indicate perforation, exploration should be promptly made. When the patient's condition contraindicates a general anesthesia, which is very rarely, the opening should be made under cocain. Reported cases teach us that operation may save life when the patient is seemingly hopeless. Although prompt operation should be advocated and practiced, my personal experience teaches that all hope is not lost even at a late date. Of three cases of typhoid perforation operated on the only one that lived was operated on three days after the perforation occurred.

Although surgeons have long and persistently advocated early exploration in obstruction of the bowels, our medical confrères, with many honorable exceptions, have not yet grasped the situation. The attitude of many medical men in this matter is beyond comprehension. With a 95 per cent. mortality rate staring them in the face they very often neglect to call in the surgeon until it is too late. Our homeopathic brethren are the worst offenders in this grave matter, for they usually give the patient a dose of medicine every fifteen minutes until he dies. The excuse usually given by the medical man for his neglect in these cases is that he was not sure of his diagnosis, and that he does not approve of the knife as a diagnostic agent. Exploration has enabled us to reduce the medical mortality of 95 per cent. in these cases to 45 per cent., and when we secure the co-operation of all practitioners it will fall much lower.

At this point I can not refrain from calling attention again to the restrictions that should be thrown around exploratory abdominal operations, for it is worse than useless for an inexperienced operator to open the abdomen in suspected perforation, or in cases of obstruc-

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tion of the bowels, except when the obstruction is caused by strangulated hernia.

Chronic peritonitis is a condition very frequently demanding exploration. When the condition is tubercular the operation *per se* will often prove curative. We have learned with the development of abdominal surgery that the old idea that all cases of chronic peritonitis are tubercular was a mistaken one. The majority of cases of chronic peritonitis are the sequels of acute appendicitis, salpingitis or cholecystitis, but a great many cases develop independent of an acute inflammation. There are many chronic invalids in every community suffering from peritoneal adhesions caused by chronic non-tubercular peritonitis who could be restored to health and comfort through an exploratory opening. It is very important to remember that a patient may be a great sufferer from peritoneal adhesions who has never had an acute abdominal inflammation. When making an exploratory operation in a case of suspected peritoneal adhesions it is very important to so locate the incision that all parts of the abdomen may be reached. My personal preference is for an incision through the right rectus muscle, large enough to admit a hand, thus enabling the surgeon to explore the pelvis, the appendix and the gall bladder.

In conclusion, allow me to express the hope that this brief paper will be understood as denouncing the abuse of exploratory incisions as emphatically as it advocates their use. An earnest endeavor has been made to make such clear statements that no honest man can offer them as an excuse for the unwarranted substitution of the knife for surgical knowledge or diagnostic ability, and to convince the doubting ones that their refusal to use the knife as a means of diagnosis where other means have failed is to sacrifice human life on the altar of prejudice.

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SUPPRESSION OF URINE.

WITH REPORT OF A CASE ENDURING EIGHT DAYS; RELIEVED BY DECAPSULATION OF THE KIDNEYS.

HORACE J. WHITACRE, M.D.
CINCINNATI.

The subject of suppression of urine has been forcibly called to the mind of the writer by a rather unusual case which it is believed may serve as a just basis for the discussion of this topic. This case will first be reported in detail, then certain general considerations will be presented.

THE CASE REPORTED.

Mrs. L., aged 40, slight in figure. The family history is negative as regards transmissible disease. The personal history is that of an individual who has enjoyed unusually good health, who was married at 19 and has born 5 children, 2 of whom are dead. The living children are 11 years, 9 years and 17 months of age, and are in good health. She has had two miscarriages, one four years ago, the other six months ago. She has always done her own housework, leads an active and practical life, and has impressed the writer with the fact that she possesses more than the usual amount of good common sense. She gives no history of previous disease of the kidneys.

About the middle of February, 1903, she found herself to be about six weeks pregnant and under stress of household worries was led to adopt measures which would relieve her of this added responsibility. She took a medicine, the principal ingredient of which was ergot, in uncertain quantities for several days without definite result, then inserted a catheter into the womb. A considerable amount of bleeding followed and continued for several days. On Wednesday, February 25, she became very feverish and sent for her family physician, Dr. Frank Perry of Norwood, Ohio. Dr. Perry found the patient in a decidedly anemic condition, with a pulse of 110 and temperature of 104 F. There was a bloody discharge from the vagina. She said that she had discharged a fleshy mass which she considered to be the

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fetus and afterbirth. Dr. Perry gave her a thorough vaginal, then an intra-uterine douche of hot lysol solution, one teaspoonful to two quarts of water and prescribed quinin in 5-grain doses every three hours per mouth.

On the following day, Thursday, February 26, her temperature was 100 F. and her general condition satisfactory. She complained of some pain in urination, however, and at about noon passed 8 ounces of urine, which was very thick and highly colored.

On Friday, February 27, the general condition continued to be satisfactory, but she had passed no urine since the preceding day at noon. She was catheterized, but no urine was found. The catheter was pinched and withdrawn and found to contain ten drops of brick-colored fluid, which was considered to be bloody urine. The bladder was irrigated and infusions of digitalis, large amounts of water and fluid diet were prescribed.

On February 28 no urine could be obtained by catheter, but she stated that a few drops had passed. Acetate of potash and saline purgatives were added to the medication. The writer was asked to see the patient in consultation on this date. The temperature, pulse and respiration were normal, the patient was very cheerful, and stated that she did not feel sick at all. The pupils were normal in size and reaction to light and there was no disturbance of vision. Feeling that she needed careful nursing and hot air baths her removal to Christ's Hospital was advised. This advice was followed and she was admitted to this hospital at 7:40 p. m., with a temperature of 98.8, pulse 88, respiration 20. She was catheterized again, but no urine was found. At 9 p. m. she received an intravenous injection of 60 ounces of normal salt solution. The condition was believed to be the result of circulatory disturbance in the kidney, and it was hoped that the intravenous injection of salt solution would equalize the blood distribution and stimulate vasomotor coordination. At 10 p. m. she had a moderately severe chill, with a temperature of 101.6 F. After which she was given hot drinks in abundance and perspired very freely.

THIRD DAY OF SUPPRESSION.

March 1.—At 1:30 a. m. she passed one-half ounce of urine. At 3 a. m., six hours after the first, she received a second intravenous injection of 60 ounces of normal salt solution. During this day her temperature, pulse and respiration remained practically normal. She was given infusion of digitalis as a diuretic and vasomotor tonic. She was purged freely with Epsom salts, 24 watery stools being recorded. She received two hot-air baths. The loins were cupped for 15 minutes. Sixty ounces of salt solution were injected into the veins at 10 a. m., and again at 8 p. m. The most trustworthy of our nurses were assigned to the patient and instructed to make absolutely

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certain that no urine was passed without our knowledge. The patient was, therefore, catheterized before each stool and pads placed under her for the detection of any urine that might be passed surreptitiously; 40 minims were obtained at one time, 15 at another, and two or three at still other times. The sum total of urine passed during her first 24 hours in the hospital was about five drams. This urine contained a heavy percentage of albumin, no casts, white blood and round epithelial cells and a few red blood cells. The urea percentage was 1.4, as estimated by the Doremus apparatus.

FOURTH DAY OF SUPPRESSION.

March 2.—Patient's temperature varied from 98.6 to 99.8 F., the pulse remained at 70, and respirations at 20. She continued to feel well except for the weakness consequent to such vigorous purging and such continued disturbance. It will appear from the record that the patient was very much disturbed during her first twenty-four hours in the hospital, but she was given, in so far as was possible, the extreme care from muscular exertion and irritation that is accorded the patient who suffers from severe surgical shock. On this date, March 2, she was perfectly composed and had no aches nor pains. Diuretin was now substituted for infusion of digitalis and calomel in one-fourth grain doses given first every hour, then continued as a three-hourly medication. On this day she was taken to the operating room and her uterus emptied by curettage of a large amount of decomposing placental tissue. This was done without an anesthetic. The interior of the bladder was at the same time cursorily examined with a cystoscope and found to be both normal in appearance and empty. During this day the bowels moved seven times, and the stool contained blood. The patient vomited a great deal and did not retain much nourishment. The diuretin seemed to be the cause of the gastric irritation, and was discontinued after 12 hours' trial. The total amount of urine obtained by the many catheterizations did not exceed thirty drops. The hot-air baths were continued, but no more salt solution was injected into the veins. It was considered that in the absence of results from the injection of 8 quarts in 24 hours nothing could be expected from further repetitions of the dose. The patient slept fairly well.

FIFTH DAY OF SUPPRESSION.

March 3.—Temperature remained below 99.6 F., pulse 74 to 80, respiration 20. Calomel was continued in one-fourth grain doses every three hours. The bowels moved 7 times. Steam baths, for 25 minutes, were continued. Patient continues to vomit. A sum total of ten drops of urine was obtained by catheterization during the 24 hours. The stool of the patient was examined for urea and found to contain 0.6 per cent.

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SIXTH DAY OF SUPPRESSION.

March 4.—Temperature 98.2 to 98.8 F., pulse 70 to 84, respiration 20. Patient slept a great deal. Bowels did not move so freely. An attempt was made to place patient in cabinet bath, but she was too weak to sit up and the steam baths were therefore continued. The patient felt well while in bed. She complained of no headache, no ocular symptoms; in fact, no pains in any region. The calomel was continued. Ten drops of urine are recorded for this period of 24 hours. The character of this urine remained the same. The stool of the patient was again examined for urea and found to contain 0.7 per cent. The uterus was irrigated because of a continuance of a discharge from the external os. On this date patient was taken to operating room, and a second examination of bladder made. The bladder was normal in color, not inflamed and empty. No water could be seen to issue from the ureters and certainly none collected in the bladder during the half hour that the examination was continued with the bladder distended by air. There was no evidence of a calculus in the orifice of either ureter and no bulging at this site. On the contrary, the right ureter was widely open. During each day of the disease the kidneys were both thoroughly and satisfactorily palpated with a view to detecting a developing hydronephrosis from simultaneous obstruction of the ureters by calculi. The kidneys could be felt to be somewhat enlarged from the start, but there seemed to be no progressive increase in their size.

SEVENTH DAY OF SUPPRESSION.

March 5.—Temperature remained 98.6 F., pulse 72 to 90, respiration 20. General condition shows marked failure in strength. The patient slept most of the time and was aroused with difficulty. Citrate of magnesia was given; strontium bromid was given in 10-grain doses every four hours as a diuretic. Calomel was continued. Bowels moved eleven times. Urine was obtained four times by catheter; on two occasions one dram was obtained, on another one-half dram, on another four drops. This urine was examined carefully. The reaction was acid, color amber and cloudy, albumin was present in considerable amount, sugar was absent. The urea percentage was 1.4. On microscopic examination no casts were found, but three varieties of cells were present—white blood cells, bladder epithelial cells and round kidney cells. The white blood and the bladder epithelial cells presented the usual appearance, but the kidney cells presented a most striking example of fatty degeneration. This condition of the kidney cells had been noted in the urine of the preceding days, but to so slight a degree that it was not given much thought. The four specimens obtained at different times on this seventh day of the suppression demonstrated a very rapidly-increasing number of these fatty

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cells until the evening specimens presented a most striking picture.

The rapidly increasing numbers of degenerated kidney cells were considered to indicate that the kidney parenchyma was undergoing rapid degenerative changes by reason of the prolonged stasis of blood in its vessels. It was taken as an index of the pathologic changes taking place in the kidney and as a finger-board pointing out the correct line of treatment.

The condition of this patient had been explained from the start, in the writer's mind, on a basis of vasomotor disturbance whereby a stasis of blood, probably under great tension, had occurred in both kidneys. Blood was not flowing through the glomeruli, therefore the secretion of urine was in abeyance. The medication employed was directed to a re-establishment of this circulation and to an elimination of as much urea as possible by way of the skin, bowels and lungs. A continuance of this medication and general line of treatment was believed to be justifiable so long as the condition of the patient remained fairly good. Nevertheless, the operating-room force was held in readiness during this entire time for such operative treatment as might be demanded.

The definite evidence of rapid degenerative changes in the parenchyma of the kidney seemed to the writer to present a positive indication for such operative intervention and the patient was accordingly prepared for this treatment.

On March 6, and at the completion of her eighth day of suppression, the patient was taken to the operating room. Chloroform was used as the anesthetic. The right kidney was exposed by an oblique incision in the loin through all structures (the possibility of extension of the incision for the exploration of the ureters made a muscle-splitting operation undesirable). This kidney was certainly one-half larger, if not double the size of a normal kidney. Its external surface presented a mottled, purplish-blue appearance which at once suggested the appearance of the face of a baby whose head had just been born with the cord compressed. The kidney was lifted from its bed and

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the body of the kidney, the pelvis and the ureter thoroughly palpated. Nothing abnormal could be found and the pelvis certainly was not dilated. A hollow needle was thrust into the pelvis through the cortex for the double purpose of probing for stone and drawing off urine from a dilated pelvis. This investigation gave negative results.

The opinion already expressed regarding blood stasis seemed confirmed and the capsule of the kidney was split from end to end and totally removed. When an incision was made in the capsule its edges retracted and the cortex bulged through the incision as if under great tension, this in a manner entirely analogous to that seen in brain operations when the dura is opened. Very free hemorrhage followed the separation of the capsule from the kidney, but this membrane was nowhere firmly attached to the cortex by fibrous wedges projected inward. The capsule was of about normal thickness and was stripped off easily. The kidney parenchyma was of a yellowish-gray appearance after the blood-letting of decapsulation and was so brittle that the slightest touch of an instrument seemed to lacerate it. At one time my assistant changed the position of a very blunt abdominal retractor, and in so doing struck the convexity of the kidney. A lacerated wound three-fourths of an inch long and one-half inch deep resulted. The naked eye appearance of the cortex was that of marked fatty degeneration. The capsule of the kidney was entirely excised, the kidney dropped back into its bed, gauze drainage was inserted and the external wound closed. A provisional stitch was inserted for the purpose of completing the primary closure of the wound after the removal of the drainage 24 hours later.

Exactly the same procedure was immediately applied to the left kidney. This organ presented precisely the same anatomic conditions; the pelvis was likewise found to be free and the capsule was removed. The time consumed in the double operation was 45 minutes. The patient stood the operation perfectly well, her pulse did not exceed 100, and she was put to bed in a most satisfactory condition. At the time of her return to bed the pulse was 70 and the respirations 20 per minute. There was no vomiting from the anesthetic.

One hour after operation the patient expressed a desire to urinate and two ounces of intensely bloody urine were obtained by catheter. This urine was neutral in reaction, albumin was abundant in a filtered and centrifuged specimen and the urea percentage was 1.4. Microscopically red blood cells were present in large numbers; the same round cells presenting in advanced stage of fatty degeneration were found in abundance, but no casts.

The temperature remained normal throughout the remainder

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of the day, the pulse varied from 72 to 80, the respirations from 24 to 28.

At 6 p. m. (six hours after operation) 2¼ ounces of urine possessing the same naked eye, chemical and microscopic characteristics were voided by the patient.

At 9 p. m. 1¾ ounces of urine of similar nature were voided.

The patient was given water per mouth in six hours after operation.

At 1:30 a. m. 2 ounces and at 5:30 a. m. 4¼ ounces were passed. Three ounces at 8:30 a. m., and 4 ounces at 11:40 a. m., gave a sum total of 21 ounces of urine passed in the first twenty-four hours after operation.

The urine continued to be intensely bloody, the reaction became acid at 1:30 a. m., the specific gravity was 1,009, and the urea percentage had diminished to 1 in the morning urine. The fatty cells persisted to the end of the twenty-four hours. An 8-ounce bottle containing the first urine passed showed a red deposit ¼ inch thick after settling for a few hours. The patient was rather drowsy during the day, had some abdominal pain, and vomited once.

The second twenty-four hours after operation, the temperature, respiration and pulse remained normal. The urine was passed in from 3 to 10-ounce quantities and aggregated 48 ounces. The blood rapidly disappeared and the urine became amber color by the end of this period. The reaction continued to be acid. The specific gravity did not vary from 1,008. The urea percentage varied from .85 to 1.5. Albumin was present. Red blood cells were always present microscopically. The fatty cells had disappeared by the end of the period. No casts were found in any specimen.

The patient rested well, took liquid food with much indifference, and vomited bile once or twice. She was delirious for two hours during the night, but slept well with this exception. The gauze drainage was removed and the provisional sutures tied.

The third twenty-four hours after operation, temperature, respiration and pulse remained normal. The amount of urine aggregated 89 ounces. The character was about the same as that during the second 24 hours except that it became bloody again for about six hours, then returned to amber. The patient rested well. The diet consisted of toast, egg, cocoa, oyster broth, ice cream, and orange albumin water. There was great prostration, but patient was cheerful. The bowels moved well.

The fourth twenty-four hours, temperature, respiration and pulse normal. Total amount of urine 56 ounces. Urine clear; very few red cells; no casts; trace of albumin; specific gravity 1,009; reaction acid; no sugar.

The fifth twenty-four hours, temperature, respiration and pulse normal. Total amount of urine 77 ounces. General condition good. Quality of urine the same as during the fourth

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day. Appetite vacillating. Some delirium at night, yet patient slept well. Patient received eggnog and strychnin sulphate grs. 1/60 as continuous tonic stimulation.

The sixth twenty-four hours, temperature and respiration normal. Pulse became elevated to 100. Total amount of urine 64 ounces. Urine amber color and cloudy; reaction acid; specific gravity 1,009; trace of albumin; no sugar. Microscopically amorphous urates, a very few red blood cells and no casts were found. Urea percentage 1.4.

The seventh twenty-four hours, temperature 98.4 to 99.2, pulse 90 to 120 and bounding, respiration 20 to 26. Total amount of urine passed 47 ounces. Quality of urine same as on sixth day. Patient felt very weak and looked very pale, but said that she had no pain and felt very well. Appetite failed somewhat.

The eighth twenty-four hours, temperature, respiration and pulse normal. Total urine 52 ounces. Quality same as on sixth day.

The ninth twenty-four hours, temperature 90 to 102, pulse 108 to 120 and bounding. Respiration 24. Total urine 45 ounces. Quality of urine same, except that it is now perfectly clear. No explanation could be found for the rise in temperature and pulse rate. One physician who saw the patient at this time stated that the pulse was that of a patient just previous to puerperal eclampsia and advised the use of a veratrum viride. This was not given, however.

The tenth day, temperature 99 to 101, pulse 80 to 100, respiration 24. Total amount of urine 44 ounces. General strength improved, patient feels better and asked to get up. Quality of urine the same as on sixth day.

During the eleventh day the total amount of urine was 47 ounces; during the twelfth day 52 ounces; during the thirteenth day 48 ounces; during the fourteenth day 78 ounces; during the fifteenth day 62 ounces; during the sixteenth day 65 ounces; during the seventeenth day 47 ounces; during the eighteenth day 64 ounces; during the nineteenth day 80 ounces. On this date the patient returned to her home, and the husband has reported that the total amount of urine has averaged from four to four and one-half pints per day for every day since March 25.

The temperature returned to normal after the tenth day and remained so. The strength of the patient improved steadily, and she sat up on the sixteenth day after operation. The appetite improved rapidly until it became normal. The urine became normal on the seventeenth day.

It is believed that this patient suffered from a vasomotor suppression of urine. There are two factors which may have acted in a causative relationship to the condition. Either the ergot which was contained in the em-

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menagogue caused a strong and persistent vaso-constriction, or a strong reflex was communicated to the kidney at the time of the destruction of the ovum or by the uterine irrigation. Neither of these could be called an overpowering reflex, and it is certainly true that such a result would be most unusual, yet at the same time we must take into consideration the fact that the susceptibility of the nervous system to irritation and to reflex, particularly in women, is a most variable quantity. The patient was not exposed to conditions which would cause an acute nephritis, nor did she present the slightest symptom of this disease at any time. She was perfectly well up to the time of the destruction of the ovum. The temperature which she presented at the time of Dr. Perry's first visit is not believed to have been the result of septic infection, since it disappeared after one flushing of the uterus, and the material found in the uterus at the time of curettage did not seem to be infected. It is, of course, possible that there was some absorption of decomposition products into the general circulation, yet in the absence of any disturbance of the temperature and pulse rate it is difficult to believe that these products were very poisonous.

GENERAL CONSIDERATIONS.

The writer has been impressed on more than one occasion by the fact that our ready reference text-books of surgery contain little or no mention of the subject of suppression of urine. The condition is given a brief mention as a symptom, in connection with certain surgical diseases of the kidney and ureter, but is nowhere discussed in full, in so far as he knows, as a definite condition entitled to elaboration from the viewpoints of etiology, diagnosis and treatment. The literature on this subject, even though meager, is valuable and should be collected into such available form as will give a definite classification and a clear exposition of the subject. It has been the unfortunate experience of the writer to encounter this condition in a variety of forms;

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indeed, every surgeon has his quota of deaths after operation from suppression of urine and every surgeon knows the anxiety that is felt during the hours of its possibility and of its endurance.

It has been stated that suppression of urine is merely a symptom and not a disease. It is certainly true that suppression of urine may be but a single symptom in the picture of a given disease, e. g., cancer of the uterus with involvement of the ureters, but it is likewise true that in the majority of cases which are presented to the surgeon the suppression of urine is the one condition which imperatively demands treatment, and the one condition which is going to kill the patient unless relieved. Furthermore, each case of suppression of urine must be accurately and painstakingly studied from the viewpoints of etiology, pathology, symptoms, diagnosis and treatment, and it requires but slight reflection to see that the investigation and the management of these cases present unusual difficulties.

Such, it seems to the author, are the claims of this subject to a place among surgical conditions.

The present paper does not present for your consideration a solution to the problems of suspended kidney function, nor does it furnish a full presentation of the subject. The case, which is recorded above, is offered as a contribution to the meager literature on this subject, while the appended general discussion is presented in the purely suggestive light of personal impression gained from clinical experience and from some reading.

DEFINITION.

Suppression of urine is commonly defined as a condition in which the excretion of urine from the tubules of the kidney is entirely suspended or in which no urine is transmitted to the bladder. This definition is made to cover two distinct conditions and is believed by the author to be open to criticism. It would seem more accurate to omit the latter clause and say that suppression of urine is a condition in which the excretion of

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urine from the parenchyma of the kidney is suspended. When one or both ureters are mechanically obstructed the parenchyma of the kidney continues to perform its functions until a quantity of urine varying from a few ounces to one gallon has been secreted and until the pressure has become sufficiently great to arrest secretory pressure. When the urethra is mechanically obstructed the same accumulation of urine occurs behind the obstruction and the same result may follow in the kidney. Yet an accumulation of urine behind an urethral obstruction is called retention of urine, that behind an ureteral obstruction a suppression of urine, and the two are carefully differentiated. To my mind they are in reality one and the same lesion, except for the location in the tract of the obstruction, in the seriousness of the condition and in the accessibility of the lesion. The one may be diagnosticated and relieved by urethral, the other by ureteral examination and catheterization. Furthermore, the correct surgical treatment in each case is directed to the seat of mechanical obstruction with the one purpose of liberating the pent-up kidney secretions and of preventing or relieving serious secondary lesions in the kidneys.

In suppression of urine, as defined, the secreting mechanism itself is at fault; the lesion is primary in the kidney, and no urine is separated from the blood. The treatment of the condition must be based on entirely different grounds, and the lesion must be studied from the physiologic side.

We have, then, two distinct conditions, the one mechanical and always surgical, the other physiologic and sometimes surgical, and each worthy of careful study from the viewpoint of etiology and pathology. An appropriate division of that condition in which no urine is discharged from the body would seem to be: 1. Vesical and urethral retention or obstruction of urine. 2. Ureteral retention or obstruction of urine. 3. Suppression of urine.

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It is believed by the writer that the above modifications in the definition of suppression of urine or anuria should be made. Yet the present discussion of the condition will be pursued according to the usual definition and a division of the subject will be made into an obstructive and non-obstructive form, each of which may be elaborated under the heading of etiology.

ETIOLOGY.

The condition presented to the physician is one of "no urine," and it becomes necessary for him to seek the cause of this condition. The following table is offered as a concise statement of the causes of suppression of urine.

I. OBSTRUCTIVE SUPPRESSION OF URINE may result from:

A. A calculus, a blood clot or a plug of pus in the ureter. This may cause complete obstruction.
  (*a*) In the ureter of the only existing kidney.
  (*b*) In a single fused ureter from the two kidneys or from a horseshoe kidney.
  (*c*) In the ureter of the only functionating kidney, the other kidney having been previously destroyed by calculous obstruction, tuberculosis, nephrolithiasis, suppuration, tumor, cyst, etc., etc. This is by far the most common form.
  (*d*) From the simultaneous obstruction of both ureters (rare).
B. Stricture of the ureter under the four above-named conditions.
C. Kink in the ureter of a floating kidney or angular attachment of the ureter to the pelvis under similar conditions.
D. Tumor of the kidney.
E. Tumor of the base of the bladder or of other organ involving both ureters.
F. External pressure.
  (*a*) Myomata of the uterus.
  (*b*) Cancer of the uterus or rectum.
  (*c*) Abdominal tumors.
  (*d*) Laceration of the cervix with subsequent involvement of the ureter in the cicatrix.
G. Venous congestion. An excessive degree of exudate when associated with congestion of the intertubular veins may cause a degree of lateral pressure which may result in suppression. The suppression of urine in the author's case may be explained in this way.

II. NON-OBSTRUCTIVE SUPPRESSION OF URINE may occur as a result of:

A. *Reflex circulatory* or *vasomotor disturbance* in the kidney. This may occur—
  (*a*) *After operations* which concern in any way the complex sympathetic nervous mechanism of the abdominal cavity, *e. g.*, nephrectomy, nephrotomy, operations on the bladder, operations on the male or female genital tract.
  (*b*) After the *passage of a catheter* or a sound into the bladder. This agent may act either as a reflex or as a septic infection.
  (*c*) As a result of the *lodgment of a calculus* in one ureter, the other remaining free. The reflex in this case may result either from the nerve irritation at the site of lodgment of the calculus or from the acute tension which occurs within the pelvis of the obstructed kidney.
  (*d*) *Trauma*, subcutaneous or direct. In a case related by Dr. Oliver, a bullet merely cut a groove in the convexity of one kidney yet the patient died from suppression of urine.

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(*e*) *Hysteria.*
(*f*) *Drug vaso-constriction, e. g., ergot,* auto-nephrotoxins.
(*g*) *Extensive burns,* may act either by a reflex or by sepsis.
(*h*) *Meningitis.* (A case reported by Fussell, in *Pediatrics,* August, 1901.)

B. Degenerative changes in the kidney. These may result from:
(*a*) Poisoning by drugs such as phosphorus, carbolic acid, cantharides, turpentine, etc., possibly by ether and chloroform when used for surgical anesthesia.
(*b*) Acute infectious diseases such as septicemia, cholera, scarlet fever, dysentery, etc.
(*c*) Acute nephritis.
(*d*) Auto-nephrotoxins. This is a toxic product, a cytotoxin, which is formed as a result of active disintegration in one kidney and which acts to produce marked degenerative changes in the opposite sound kidney. Castaigne and Rathery suggest that perchance certain renal disturbances now described as the result of reno-renal reflex nervous influences or as sympathetic nephritis are the outcome rather of auto-nephrotoxins.
(*e*) Tubercular or cystic disease of both kidneys may progress to the total destruction of all secreting tissue.

C. The direct effect of lessened heart force. When the aortic pressure sinks below 40 mm. Hg. the urinary secretion stops absolutely. So long as the blood pressure is above this height the secretion is more or less proportional to the pressure, and changes with the changes in this pressure.

D. Trauma.
(*a*) Direct paralyzing injury to both kidneys or to one kidney when the other is non-functionating.
(*b*) Rupture of the *kidney,* the *ureters,* or the *bladder* with extravasation into the tissues of all urine secreted. This must be included under the old definition of suppression of urine, but is not believed to belong to the subject at all.

E. Anesthesia. It would be very difficult to classify this etiologic factor more accurately, for the reason that we do not certainly know the exact manner in which these drugs act on the kidney. Kemp concludes that ether, while producing a rise in general arterial pressure, manifests a deleterious and specific influence in a lowered renal pressure and almost immediate diminished secretion, whereas chloroform, when producing a decrease in carotid pressure, exerts but an insignificant effect if any on the renal pressure or excretion. On the other hand, Gallcazi and Grillo maintain that the diminution of renal permeability is more marked when chloroform is used than when ether is administered, and they claim that this result renders any infectious disease with which the patient so anesthetized may be affected more severe.

PATHOLOGY.

A complete study of the pathologic lesions mentioned above as etiologic factors would be both impracticable and undesirable in the present paper. The pathology of those conditions enumerated under the heading of obstructive suppression is so well understood and so well described in all text-books of pathology that its recapitulation is considered unnecessary. The same may be said of some of the conditions included under the heading of non-obstructive suppression, yet it is this particular section of the subject which presents the perplex-

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ing questions, and hence it is this section which should receive most attention.

In view of the fact that we are dealing with alterations in the functional value of the specific parenchyma of the kidney, it is certainly true that we will find a physiologic basis to be the correct one on which to construct our pathologic and therapeutic superstructure.

PHYSIOLOGIC CONSIDERATIONS.

The kidney is a compound tubular gland in which the vascular apparatus is so arranged as to afford (*a*) the most favorable conditions for filtration of the liquid parts of the blood, and (*b*) the most favorable conditions for the elimination of the waste products of body metabolism by its specific excretory cells. The secretion of this gland is complex in its composition, contains most of the end products of the varied metabolism of the tissues and represents the most vital excretory product of the body. This secretion may be looked on as a solution of a great number of organic and inorganic substances in water.

The nerve supply of the kidney is vasomotor (vaso-constrictor and vaso-dilator) and secretory. The vessels of the kidney, like those of all parts of the body, are under the direct control of the central nervous system. The secretory nerves are not fully understood. The nerves are definite off-shoots from and an integral part of the vast abdominal sympathetic system, and are connected with the spinal cord through the anterior roots of the eleventh, twelfth and thirteenth dorsal nerves. These nerves enter the hilum of the kidney both as a plexus closely investing the renal artery and as fibers which run parallel to the vessels and can be traced as far as the cortex.

The secretion of urine consists of two distinct processes: (1) The secretion of water and salts, and (2) the elimination of urea and related bodies. The secretion of the waters and the inorganic salts undoubtedly takes place through the glomerulus. The excretion of urea and re-

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lated bodies is believed to take place through the agency of the epithelial cells lining the convoluted tubules. These cells perform the function of secreting the specific nitrogenous elements of the urine, which are taken up into solution by the water which flows downward from the glomerulus and a completed urine is formed.

The secretion of water and inorganic salts seems to be largely, yet not entirely, a question of mechanical filtration or separation and to depend mainly on two factors.

(1) The difference of pressure between the blood in the glomerular capillaries and the urine in Bowman's capsule. The pressure in the tubule is practically *nil* under normal circumstances, so that the only changeable factor will be the blood pressure in the capillaries.

(2) The rapidity of the blood flow through the glomeruli. The more frequently the fluid is presented to the filter the more rapidly will the process go on.

The glomerular circulation may be affected in several ways. The pressure in the glomerular capillaries will be raised and the velocity of the blood increased:

(1) By a rise in the general blood pressure. This may be due to (*a*) increased force and frequency of the heart, (*b*) constriction of vascular areas in other parts of the body.

(2) By dilatation of the renal arterioles, the general blood pressure remaining constant.

(3) By obstructing the renal vein. In this case the velocity will be diminished.

The pressure and velocity in the glomerular capillaries will be diminished:

(1) By diminished general blood pressure, which may arise from a weakening or slowing of the heart beat, or from dilatation of vascular areas in other parts of the body.

(2) By constriction of the vessels in the kidney itself.

As has been stated above, a diminution of aortic pressure below 40 mm. Hg. results in an absolute cessation of secretion and variations in pressure above this point

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will be followed by corresponding variations in the amount of urine secreted.

It is to this vasomotor mechanism of the kidney that we must look for the regulation of the flow of blood through the kidney, hence for a rational explanation of variations in the secretion of urine.

Stimulation of the vaso-constrictor fibers causes contraction of the arteries of the kidney, a diminution in the size of the organ and a diminished secretion of urine. Stimulation of the vaso-dilators will have precisely the opposite effect. Both of these sets of fibers are probably brought into play under normal conditions by reflex stimulation, and thus serve to regulate the flow of blood through the kidney and thereby influence its functional activity.

It has been estimated that, in strong diuresis, 5.6 per cent. of the total quantity of blood sent out of the left heart in a minute may pass through the kidneys, although the combined weight of these organs makes only 0.56 per cent. of that of the body.

That the formation of the water of the urine is not entirely a question of filtration, however, would seem to be demonstrated by two experimental facts:

(1) Ligation of the renal vein raises the blood pressure in the glomerular capillaries almost to that of the renal artery, yet the secretion of urine is promptly arrested.

(2) Ligation of the renal artery causes a complete arrest in the secretion of urine. Removal of this ligature after a few minutes restores at once a normal circulation and pressure of blood in the glomeruli, yet the secretion of urine is not re-established for one hour, and when it does return it contains albumin.

These facts have led Heidenhain to believe that the secretion of water depends on the active intervention of special secretory cells, and that any agent which interferes with the physiologic value of these epithelial cells

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covering the glomerulus will result in corresponding alterations in the amount and the quality of urine secreted. If such an explanation is correct we will find in this physiologic fact a most valuable aid to the explanation of degenerative suppression of urine. Furthermore, in those forms included under the head of venous congestion the direct causative factor may be a decreased secretory power or a decreased permeability of these cells, which has resulted from an insufficient blood supply.

It must be admitted, however, that physiologists are not yet agreed on all points concerned in the secretion of water, and it seems clear that at present we are not justified in asserting more than that the glomeruli control in some way the production of the water and salts of the secretion. The extent of the activity seems to be correlated with the quantity of blood flowing through the glomeruli.

It is a fact of some importance in the present study to note that the most important of the pathologic constituents of the urine, such as albumin, hemoglobin and sugar, seem to escape from the blood into the tubules through the glomerular epithelium.

The exact nature of the forces involved in the excretion of urea by the actively secreting cells of the convoluted tubules is not entirely understood. The normal stimulus to these cells seems to be the presence of urea and related substances in the blood and the rate of elimination will vary, under normal conditions, (*a*) with all variations in the percentage of urea in the blood, and (*b*) with the velocity of the blood flow through the capillaries. The elimination is not a simple act of diffusion, because the percentage of urea in the urine is greater than that in the blood. All that we can say is, that in some way the urea is selected from the blood and quickly transferred to the lumen of the tubule without alteration in chemic composition and without accumulation in the cell.

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Reflex Vasomotor Suppression of Urine.—The kidney parenchyma, it will be remembered, is enclosed within a firm unyielding capsule, analogous in every way to the capsule (sclera) of the eye and the bony casement of the brain. Under normal conditions a vaso-constriction diminishes the amount of blood entering this capsule, the kidney capillaries become anemic, and an amount of blood escapes through the veins exactly equal to that which enters. Under normal vaso-dilator action the amount of blood entering the closed sac is exceedingly increased, the entire organ increases in size, the capsule becomes tense, yet again the venous return is entirely efficient and carrys off an amount of blood exactly equal to that which enters. The blood circulation through the kidney is perfect in each instance, but the amount of blood flowing through the organ is widely different. The regulation of the exact amount of blood that shall flow through the kidney, it will be remembered, is the direct result of what may be called normal reflex stimulation.

Now, suppose we have an overpowering stimulation of any part of the abdominal nerve plexus, an overpowering reflex, such, for instance, as will result from a nephrectomy. One of three things may happen in the remaining kidney:

(1) There may be an intense stimulation of the vaso-constrictor nerves which will cause a temporary or persistent cessation of blood flow through the glomerulus.

(2) There may be a sudden paralysis of the vaso-constrictor nerve fibers and an increased flow of blood to the kidney; or there may be

(3) A marked stimulation of the vaso-dilator fibers and again an increase in the flow of blood into the kidney.

Intense Stimulation of the Vaso-constrictors.—This may be expected to cause a temporary or perhaps a somewhat continued arrest of blood flow into the kidney.

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The secretion of urine will immediately stop. The kidney will become anemic and the blood contained in the organ will flow off through the veins. Now, it has been demonstrated anatomically that the kidney receives a feeble anastomotic circulation through its capsule. Furthermore, it has been demonstrated that simple ligature of the renal artery will cause a condition of red infarct in the kidney, while the ligature of this artery, after the complete removal of the capsule, will result in a condition of white infarct. This means that after ligature of the renal artery blood flows through this anastomotic circulation into the kidney in sufficient quantity to engorge the vessels, yet under insufficient pressure to reestablish the circulation of the blood through the organ. A condition of red infarct results. When the capsule is removed, however, this anastomotic circulation is cut off and all blood left in the kidney drains off, leaving the capillaries empty and the tissues white.

Precisely the same conditions are presented when a sudden vaso-constriction closes the vessels of the kidney. The blood flow is arrested and this same anastomotic circulation engorges the capillaries and veins of the cortex. The endothelial cells in the walls of the capillaries and the small veins have suffered a degenerative change, however, because of the arrest of blood, and they permit the serum to leak out between the tubules. Now, since it is improbable that a complete obliteration of the arterioles by vaso-constriction could endure for a very extended period of time, let us see what would happen when these arterioles begin to open again. Blood is once more pumped into the kidney, but the venous return is seriously impeded by the lateral pressure of the exudate which has formed around and between the paralyzed veins and the tubules. The congestion of the vessels of the kidney becomes more intense with each heart beat, and a condition analogous to experimental ligature of the renal vein ultimately results. The blood flow through the kidney is stagnant, no urine is secreted,

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the capsule becomes over-distended and tense, the blood becomes highly venous and the kidney parenchyma suffers serious degeneration from insufficient oxygen and food supply. This is precisely the lesion found at the time of operation in the kidneys of the patient whose case has been reported in this paper.

Should the overpowering stimulation of the nervous mechanism of the kidney result in either a paralysis of the vaso-constrictors or a stimulation of the vaso-dilators, the effect on the circulation would be the same and the reasoning as to the ultimate effect on the kidney of both would be precisely the same as that followed for the explanation of vaso-constriction suppression, except that the anastomotic circulation would probably play no part.

Degenerative Form.—It seems very easy to explain the degenerative form of suppression of urine on physiologic grounds if we give to the glomerular epithelium the pure secretory function that has been suggested. If the glomerular cells secrete the water then the correct performance of this function will be absolutely dependent on the anatomic and physiologic integrity of these cells, and any agent which causes serious degenerative changes in these cells will assuredly exert a corresponding influence on their secretory product. Such conclusions do not seem to be justified, however, by our present physiologic knowledge. At the same time there must be some connection between the normal secretion of the water of the urine and the integrity of the glomerular epithelium, be this a property of secretion or one of permeability, and it is believed that further experimental work in this direction will yield some definite results.

Lessened Heart Force.—The effect of a lessened heart force with a lowered aortic pressure finds its complete explanation in physiologic fact. The suppression of surgical shock will find its correct classification under this heading, and will be most correctly treated by directing the attention to the general circulation.

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The pathologic findings in those kidneys examined by the author after death from suppression of urine have uniformly been slight. An intense congestion of all vessels in the cortex and a marked cloudy swelling of the parenchyma cells have always been present. The intertubular area has been uniformly widened and always filled either by capillaries and veins or by a fluid exudate. The most striking feature of the lesion has always been a complete injection of all vessels of the kidney by red blood cells. An exudate within the tubules has not been observed. It has so happened that all of the kidneys examined by the writer showed either no evidence of a chronic nephritis or so slight a change that this lesion could not be considered to be a predisposing cause. As has been stated, the kidneys, exposed in the case that has been reported, showed a most intense degree of venous congestion and a very high degree of tension within the capsule; when this tension was removed and a large amount of venous blood had drained off the cortex looked comparatively pale.

DIAGNOSIS.

The condition presented to the physician for diagnosis is an absence of the usual discharge of urine from the body. The first point that must be decided is the proper classification of the particular case under the heading of either the obstructive or the non-obstructive form of suppression of urine. The determination of this one point will call for the most thorough possible history, both as regards previous illness and the existing attack. This history must deal minutely with all symptoms referable to the functional value of the kidneys, and all preceding attacks of pain in the abdomen, the loin, the back or bladder must be investigated with a view to establishing a probability or a certain diagnosis of pre-existing parenchymatous or calculous disease of one or both kidneys. It is a well-known fact that most cases of total obstruction of urine from blocking of the ureter occur in individuals who have previously suffered a destructive

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lesion in one kidney. This previous disease in the destroyed kidney may be unknown to the patient, or he may have forgotten the slight symptoms that he suffered.

The physical examination of the patient must be equally thorough and equally complete. The passage of a catheter into the bladder will rule out urethral obstruction. A cystoscopic examination will determine the presence or absence of tumor of the bladder and may detect a calculus in the vesical opening of the ureter. Catheterization of the ureter or the introduction of the wax taper, as suggested by Kelly, will determine the patency of the ureters and may give positive evidence of the presence of stone.

If the ureters are patent we may consider that the diagnosis of a non-obstructive or true suppression of urine is established. It is not always possible to apply methods of precision to this degree, however, and a diagnosis must sometimes be made on the evidence furnished by abdominal palpation and the history of the patient.

The differential diagnosis of the various conditions referred to under the heading of obstructive suppression is not believed to belong to the present study and is well described elsewhere.

A differential diagnosis between those conditions included under the heading of true suppression of urine or non-obstructive suppression will usually be made from the history of the patient alone. It will usually be self-evident that the patient has ingested a poison, that he has suffered a strong reflex, that shock is present, that the heart's action is feeble or that an anesthetic has been given.

TREATMENT.

A discussion of treatment again divides itself naturally in accordance with the general division of the subject into the obstructive and the non-obstructive form.

The Obstructive Form.—The treatment of this form of suppression is always surgical, and is always directed

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to the re-establishment of efficient excretory channels or ducts. Such methods of treatment are well described in all text-books of operative surgery. Again, it must be stated that this section does not, in the opinion of the author, belong to the subject of suppression of urine.

The Non-obstructive Form.—The first thought that will come to the mind of the majority of practitioners of medicine in the presence of any form of suppression will be, what diuretic will act most promptly?

The mode of action of diuretics is not well understood. Without entering on a discussion of the subject it may be stated that the saline diuretics, such as urea, dextrose, sodium chlorid, potassium nitrate, potassium acetate, etc., produce an increased flow of blood through the kidney, hence an increased flow of urine, by reason of an hydremic plethora which they induce. The result of injecting these substances into the blood has been proven to be an active flow of water from the tissues into the blood. The blood, therefore, becomes diluted to an extent varying with the osmotic pressure of the substances injected. Caffein again seems to produce its diuretic effect by reason of its effect on the renal vessels. The effect of digitalis, in producing diuresis, is more complex, yet it seems probable that its action may be explained by its effect on the general circulation. It slows and strengthens the heart beat and at the same time constricts the smaller arteries of the body, so that the arterial pressure is raised. Therefore, its legitimate use in suppression of urine will be restricted to those cases of heart disease in which a feeble heart action, a lowered arterial and an increased venous pressure are the cause of an imperfect flow of blood through the kidney. Under such conditions digitalis will act as a powerful diuretic.

The Treatment of Vasomotor Suppression of Urine.—It has been demonstrated that the pathologic lesion in this condition is an intense venous congestion of kidney. The blood is stagnant, the venous return is progres-

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sively more and more impaired by lateral pressure, the kidney capsule is tensely overfilled, and blood is being continuously pumped into an already overfull organ. This kidney certainly needs depletion and those measures should be applied which will withdraw blood from it.

Diuretics may act favorably on such a kidney or they may be the very worst possible thing for it. The lesion is uniformly a greatly impeded venous return from the organ or a venous stasis. Now, if by increasing the arterial pressure behind this stagnant blood it can be forced on into the renal vein, then a diuretic will relieve the existing stasis and render conditions favorable to an absorption of any exudate that may be present. Such reasoning is followed in the treatment of pneumonia, and the heart receives more attention from the therapeutic standpoint than the lung itself. If, however, the obstructive lesion in the veins has become so marked that this piling up of pressure from behind can not overcome it, then these same drugs only intensify the lesion by sending more and more blood to the organ.

It seems to the writer, therefore, that the course pursued in the treatment of the reported case was correct. Fresh infusion of digitalis was first given with a view to strengthening the heart, equalizing the circulation and restoring vasomotor tone. This failing it was deemed wise to establish a high degree of hydremic plethora by the most prompt possible means. Sixty ounces of normal salt solution were therefore injected into the veins every six hours for four doses. This measure also failed in this particular case, and in the light of subsequent history both measures probably did her kidneys more harm than good. Nevertheless, it is believed that these measures are correct and that they will serve to re-establish the flow of blood through the kidney, hence the flow of urine, in quite a percentage of very early cases.

Depleting agencies will occupy a position of high im-

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portance in the treatment. These measures are applied for two reasons: (1) For the purpose of withdrawing blood from the kidney; (2) for the purpose of removing urea from the blood. To this end cupping of the loins, free purgation and sweating with pilocarpin and hot air are to be strongly recommended. Large hot irrigations of the colon with salt solution may be tried.

OPERATIVE TREATMENT.

Should the above-named measures fail to bring about the desired result with promptness, we must conclude that the venous stasis in the kidney has attained a high degree. The operative treatment of decapsulation should then be applied. This treatment seems to the writer to meet the conditions exactly. The high degree of tension is relieved, the veins are emptied by blood letting and conditions are rendered favorable for both the re-establishment of the circulation and for the absorption of exudate. It is possible, in addition, that the massage of the kidney may in some way exert a favorable influence on its nervous mechanism. Suffice it to say that the prompt and perfect result in the case reported must be taken as definite evidence that decapsulation is a therapeutic agent of great value.

The suppression of urine that occurs in conditions of shock should be considered in the light of a symptom. Absolute quiet, external heat, elevation of the feet, intravenous injection of salt solution and strychnin will be found to be the main elements in the treatment.

Degenerative suppression of urine will require a somewhat different reasoning. The element of prime importance in the treatment will be the withdrawal of the poisonous agent. A degenerated cell or a degenerated organ is one in which the nutritional supply, the metabolic process or the process of excretion are at fault. Therefore, every measure should be adopted that will restore to the kidney a large amount of good blood and which will keep this blood in active circulation. Drugs will be of some value and salt solution will serve the

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double purpose of filling the vessels and of diluting a contained poison.

In conclusion, the statement will be repeated that the above discussion of the condition of suppression of urine is presented in a purely suggestive light, and it is hoped that it may lead to the more thorough investigation of some of the obscure points in etiology, pathology and treatment.

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FAT NECROSIS OF THE KIDNEY.

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DUBUQUE, IOWA.

When we consider the rather superficial location of the kidney, its importance and the various pathologic changes to which it is liable, it is strange that for so long a time it eluded careful examination and escaped the surgeon's knife. In the past five years, however, the surgeon has made determined, successful efforts to make good that deficit.

Fat necrosis in the tissues of the body is neither a new process nor a new discovery. It has long been recognized in the several tissues of the human body, notably in the abdomen, in the abdominal walls, in the subperitoneal fat, in omental structure and in the pancreas. For a long time it was supposed to be due to some form of pancreatic disease, but it is now well known to occur independently of any affection of that organ. The accepted physiologic view is that fat may be formed in both animal and vegetable bodies from albuminoid matters. Proteids break up in the body into nitrogenous and non-nitrogenous compounds. This is demonstrated in the human subject and by experiments on the lower animals. The non-nitrogenous compounds not being completely oxidized in the cells are formed into fat. The process actually occurs wherever fatty substitution takes place in the animal cell. Hoppe-Seyler takes the view that fat is not directly formed from albumin, but

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that glycogen is first formed and that fat is a resultant product. Volt's view, and the one generally accepted, is that fat is formed directly from proteid material. Graham Lusk,[1] after quoting various experiments along this same line, concludes, "It seems rational that in acute fatty metamorphosis of the cell that dextrose found may be quantitatively converted into fat."

The physiologic fact, I think, as well as the chemical changes underlying it, are reasonably well understood and generally accepted, but the etiologic factors, active and predisposing, are by no means clearly settled. Fat necrosis, as the term is employed in this paper, denotes a type of necrosis to which certain tissues are liable, separate and distinct from fatty degeneration. It presupposes the fact of fatty degeneration and, subsequently, a necrosis forming of the entire structure of fatty emulsion.

According to Stengel, there are a few microbes which form emulsifying ferments, which may cause this fatty emulsion. The term "liquefaction necrosis" probably better conveys the correct meaning. Ziegler says, "A liquefaction necrosis may occur in the tissues where the cell wall becomes dissolved in the fluid present in the part." "Fatty degeneration may so terminate," says this distinguished authority. Bacteria is said by some observers to be concerned in this change. The part played by these organisms is still under investigation. Dörsch says, "The cortex of the organ is most frequently involved, though the medullary portion is frequently affected in a minor degree." Hektoen considers this condition due usually to the escape of the fat-splitting ferment, resulting in the formation of fatty acids and lime salts. Gaylord states that fat in the kidneys occupies the space between the lobules in the connective tissue.

There are many causes assigned for the formation of

1. Report before the American Physiological Society, Boston, Tenth Annual Meeting.

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a fat necrosis in the tissue, either with or without liquefaction:

1. Changes in the supply and composition of the blood.

2. Diminished oxygen.

3. Blood diseases.

4. Narrowing of the arteries supplying the part. (Narrowing of the blood vessels of the heart leads to fatty degeneration, according to Hektoen.) Fatty degeneration of the kidney in pregnancy is due to disturbed circulation, says Stengel.

5. Persistent venous congestion. Displacement of the kidney producing, as it certainly does, changed blood supply, diminished oxygen, torsion of the renal artery and, together with a constant venous congestion, is a sufficient cause for liquefaction necrosis of the organ.

In the literature which I have been able to examine the references to this subject have been sparse indeed. A case is reported by Dr. T. Charlewood Turner[2] of a girl 13 years old who died of pericarditis. The autopsy revealed a fatty kidney, and he described a necrosis with softening and, though it is not distinctly stated that the necrosis affected the fatty tissue, yet from the present light I think this a fair presumption, that the softening was due to a liquefaction necrosis in the fatty substance.

Dr. Ephraim Cutter,[3] New York, contends that many organs of the body are subject to fatty substitution, and that necrosis of this fat is often present.

E. W. Cushing[4] describes the case of a patient who passed urine, one-fifth of which was oil, several days before death, and that among other things the post-mortem examination revealed a necrosis of fat about the kidney, producing oil which escaped with the urine.

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2. Transactions Pathological Society of London, 1886.

3. Paper before Mississippi Valley Medical Association, published in Medical Age, Detroit, Oct., 1895.

4. Paper before Boston Society for Medical Observation, published in Boston Med. and Surg. Jour., May 17, 1881.

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Thomas Oliver[5] reports, from his private practice, two cases of oil in the urine. He asserts that there was present in these cases a fat formation and a tendency for molecules of fat to form into globules, which, by solution of the cell wall, made their escape into the pelvis of the kidney. There is evidence enough to establish the possibility of oil formation in the structure of the kidney itself. Newbaur, in his work on the urine, speaks of the rare appearance of this constituent in the excretion derived from the kidney from this fatty substance. Fat globules are held in solution by the albumin present. Roberts, in his work on urine and urinary disease, may also be quoted to the same purpose.

It is believed, therefore, that a liquefaction fat necrosis is possible in the substance of the kidney; that a dislocation of the kidney may form the active cause for this change, and that the case briefly described below falls under this category.

April 23, 1902, I was consulted by Miss M. D., aged 22, of Welsh parentage, with unexceptional family history and personal history, free from disease, except some slight illness in childhood. She gave a history of a tumor-like mass, discovered by her about one year before, in the left hypochondriac region, extending down to two inches above the umbilicus. The November previous she consulted her physician, who found the enlargement, which he described at that time as freely movable, and made a thorough examination of the patient, with a negative result, except that he found general loss of strength and great languor. Her symptoms remained practically unchanged, except increased weakness, which led her to seek further assistance. She entered the hospital on the afternoon of April 23, and the examination which I made the following day resulted negatively, except that there was an accelerated, weakened condition of the pulse, and a tumor located as above described. The tumor seemed to be nearly one-half larger than the normal kidney, and by pressure could be returned nearly to the normal kidney location.

April 25, a lumbar kidney incision was made in the usual manner, and the kidney brought up into the wound and the fibrous capsule grasped by a clamp. The capsule gave way and there was discharged from the kidney a yellowish semi-fluid substance to the amount of 12 to 14 oz., and resembling

5. British Med. Jour., Dec. 27, 1879.

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in color an emulsion of cod liver oil and iodoform, containing a peculiar flaky or shredded material. By digital examination I found that, practically, the whole kidney substance had been destroyed. I stitched the kidney into the wound, leaving free and unobstructed drainage. Some of this semifluid material drained from the kidney for several days. Some of the material saved in the test tubes I submitted to Dr. Geo. Mengis, Dubuque, Iowa, for chemical and microscopic examination, and he reported the material composed almost entirely of an emulsion containing oil, fatty cells, together with fibrous and connective tissue. A fatty substitution had taken place in the kidney, followed by liquefaction necrosis, which had, practically, destroyed its secreting structure.

It is believed that this girl primarily suffered from a floating kidney, which, by torsion of the renal artery, produced the pathologic changes described. The recovery following the operation was uneventful, with the exception that for three or four months she suffered from weakness and rapidity of the heart's action.

In a letter received not long since from her physician, Dr. C. W. McLaughlin, Washington, Iowa, I learn that she has completely recovered. The sound kidney seems to be doing well the work of elimination.

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SURGICAL TREATMENT OF NEPHRITIS.

ALEXANDER HUGH FERGUSON, M.D.
CHICAGO.

"The Surgical Treatment of Nephritis or Bright's Disease" was the title of a paper published by me March 11, 1899, in THE JOURNAL of the American Medical Association. This is the first announcement that has ever appeared recommending a surgical treatment for Bright's disease. The date of this publication has been overlooked by Dr. G. M. Edebohls in all his articles. Dr. Edebohls' first paper, entitled "Chronic Nephritis Affecting a Movable Kidney as an Indication for Nephropexy," appeared in the *Medical News,* New York, April 22, 1899, one month and eleven days after my first article.

Feb. 10, 1899, a symposium on nephritis was the program of the Chicago Academy of Medicine, and the surgical treatment was assigned to me. At this meeting I related two cases of interstitial nephritis symptomatically cured by *decapsulation and multiple punctures.* I removed a portion of the kidney in each case, which was pathologically reported on by Drs. Klebs and Zeit, and they pronounced it interstitial nephritis. In these two instances no positive diagnosis was made before operating.

At that meeting I related several earlier cases, but inasmuch as I had not examined a section of kidney tissue microscopically in any of them, I thought it wise not to publish anything but the two cases in which that was done. Dr. R. B. Preble, while denouncing splitting

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of the capsule, etc., as dangerous and useless, terminated his remarks as follows:[1]

> While Dr. Ferguson's paper was interesting, still the bulk of the cases do not apply to nephritis at all (claiming that my diagnoses were in error), and the latter cases which were demonstrated to be nephritis have not recovered from their nephritis, but have been relieved of a purely subjective symptom.

Time has proven him to be wrong.

HISTORY.

In 1902 an article from the pen of Guiteras,[2] on the "Surgical Treatment of Bright's Disease," gave an excellent historic review of work leading up to this subject. He, too, overlooked my first publication, March 11, 1899. He gives the more recent developments, and has added three cases operated on by himself. It is my intention in this short paper to briefly give the evolution of the surgical treatment of nephritis, and add a few more cases of this disease treated surgically.

Reginald Harrison made a mistaken diagnosis in three kidney cases (1878, 1887 and 1893) of an abscess in one and stone in the other two. He cut down on them and found acute nephritis instead. It was fortunate for his patients that he and his associates were in error, for the operation cured them, and let me ask if in these cases a diagnosis of acute nephritis had then been made, would the knife have been recommended? I think not!

Newman (1896) observed in two cases the beneficial influences fixation of the kidney had on albuminuria. In 1899 Tiffany successfully incised the capsule and parenchyma of a kidney affected with chronic nephritis, complicated with nephralgia. In 1886, Péan removed a kidney for nephralgia and chronic nephritis.

In October, 1899, Pousson collected 25 cases and added 2 of his own; of hematuric nephritis, 10 cases; nephritis with nephralgia, 2 cases; subacute infectious

1. The Journal A. M. A., March 11, 1899.
2. New York Medical Journal, May 17, 1902.

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nephritis, 4 cases; acute infectious nephritis, 9 cases. The kidney was removed in 11 of these, opened in 13, and 1 exploration, with 21 reported cured. These operations mentioned by Pousson included those of Harrison, Weir and Israel, and were undertaken, not with the object of curing Bright's disease, acute or chronic, but for some suspected surgical condition, such as abscess, tumor, stone, etc.

In 1899 Israel reported 14 cases of hematuria and nephralgia treated by nephrotomy. In 12 of these there was evidence of chronic nephritis. It must be remembered that Israel did not aim at a surgical treatment for Bright's disease, and recommended an operation only when there was hematuria or nephralgia.

In November, 1890, Naunyn, in writing of nephrotomy for bleeding in nephritis, stated that "nephrotomy may some day play a far greater rôle in the treatment of Bright's disease."

Edebohls, April 22, 1899; 1901, and 1903, has given to the medical world his conceptions of the surgical treatment of nephritis, his operations and results. I wish here to commend that work. He observed the beneficial effects of nephropexy eleven years ago. "My first case was operated on as long ago as Nov. 29, 1892; my fifth April 1, 1897."[8] In speaking of his sixth case, in the same article, he says: "This operation, performed on Jan. 10, 1898, constitutes the first operation ever undertaken on the kidney with the deliberate purpose of curing chronic Bright's disease and, in so far, marks a period in the history of the affection." This case was published in his first paper (April 22, 1899), after my first publication.

Dr. Edebohls' work has taken root, and we are here and there hearing of good results from other surgeons. Physicians in the first rank recognize that there is a surgical treatment for nephritis. To Dr. Edebohls is due the credit of individually working out this surgical

8. New York Medical Record, Dec. 21, 1901.

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treatment and operating on more cases of Bright's disease than any other surgeon. While I am constrained to claim priority (first in publication), I can not but feel proud of the distinction and record the Doctor has made for himself in trying to solve the limitations of kidney decapsulation in nephritis. Dr. Edebohls'[4] published experience amounts to no less than 51 cases treated by operation. It will be seen in the description of my experience, our work has been developing contemporaneously.

I shall now very briefly refer to the development of kidney surgery before giving my personal work on nephritis. It is only thirty-five years since the kidneys have been operated on at all. Like many of the other internal organs of the body, diseases affecting them were treated by internal medication. We can appreciate how Peaslee (1868) felt when he removed a kidney by mistake, taking it for a solid ovarian tumor. Although the patient died on the third day of peritonitis, two lessons have been learned by his mistake. First, the feasibility of nephrectomy, and second, that urine was secreted abundantly by the other kidney. Spencer Wells' case also died, but not from suppression of urine.

The following year (1869) Simon of Heidelberg purposely and successfully attacked the kidney for a ureteral fistula in a woman. I have no doubt that his experiments on dogs in this line better fitted him to successfully perform the operation.

Within seven years after the first removal of a kidney by Peaslee, no less than 233 nephrectomies were collected by Gross (1885). It would take some considerable time to reckon the number of nephrectomies up to date. The operation was extended beyond its reasonable and legitimate limits. Chief among the indications for the removal of a kidney were stone, pyonephrosis, hydronephrosis, tuberculosis, floating kidney, nephralgia, hematuria, and tumors.

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4. Medical Record, March 28, 1903.

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Nephrotomy for stone (nephrolithotomy) was first performed by Morris of London only twenty-three years ago (February, 1880). Then nephrotomy gradually supplanted nephrectomy in many cases.

Nephropexy, by Hahn (1881), was the next important advance in renal surgery.

PERSONAL EXPERIENCE.

In 1899 I explored a kidney suspected of containing a stone, in a young man, 24 years of age, suffering with renal colic. There was blood in the urine, and the kidney was very tender on pressure. The exploration consisted in exposing the organ and passing a darning needle, blunt end foremost, through it in many directions. No stone was found, but temporary relief from pain and hemorrhage was given. Within a year afterward he returned to see me. Bright's disease became more and more marked, and four years afterward he died of parenchymatous nephritis.

In my early fixation of floating kidneys, I used a stout chord of chromic catgut and passed it through them four or five times and, while using this stout cord, no complaints came from our patients after the operation. But just as soon as we began to use fine catgut or silk and grasp only the capsule two cases returned, complaining of pain, as before, although the kidneys remained fixed. In 1900 I explored one of these for stone with the knife; found nothing; had free hemorrhage, which was checked with iodoform gauze. This made a symptomatic cure; the nephralgia completely subsided, and she is now well. After this I did some fixations by cutting through the capsule, rolling it a little to each side, and passing sutures through it and through kidney tissue as well, with satisfactory results.

My first decapsulation, deliberately undertaken, was for "Nephritis and Floating Kidney."

NEPHRITIS AND FLOATING KIDNEY.

CASE 1.—*History.*—June 17, 1896, Edna L., aged 25, entered the Post-Graduate Hospital complaining of a painful, tender,

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floating and enlarged right kidney. Urine scant, ℥xx in twenty-four hours; contained 30 per cent. albumin.

Operation.—Nephrorrhaphy; capsule stripped off. Urine increased in quantity, and albumin decreased. Nephritis was diagnosed as a complication. Case lost sight of (hospital record).

DOUBLE DECAPSULATION FOR NEPHRITIS AND FLOATING KIDNEYS.

CASE 2.—*History.*—Sept. 9, 1897, Mrs. B. G., aged 30, entered the Post-Graduate Hospital complaining of pain in the region of both kidneys. She had been suffering for twelve years, particularly from her right side. She was operated on three years previously for ovarian abscess, and one year previously (in 1896) for right floating kidney. Had one child twelve years of age. Her father died at 30 years of consumption. Her urine was very abundant, pale, and contained a trace of albumin. She was considered hysterical. Interstitial nephritis diagnosed. Both kidneys were floating freely.

Operation.—Capsule stripped from both kidneys, and sutured to lumbar fascia. She made a good recovery, and marvelously improved. Within six months she was able to do all her housework.

No cure was expected in this case, decapsulation being performed with the object simply of relieving her pain and tenderness. She was, two years later, symptomatically cured of her Bright's disease. It then occurred to me that all cases of tender and floating kidneys were cases of interstitial nephritis, and from this date (September, 1897) I expressed my convictions at my clinics.

MICROSCOPIC EXAMINATION OF KIDNEY TISSUE FOR THE FIRST TIME. LEFT FLOATING KIDNEY; INTERSTITIAL NEPHRITIS (BRIGHT'S). DECAPSULATION AND PUNCTURE.[5]

CASE 3.—*History.*—Mrs. M., 37 years of age and weighing 250 pounds, entered the Post-Graduate Hospital complaining of just two symptoms; (*a*) Dizziness, and (*b*) pain in the region of the left kidney. Taking morphin for the pain. Ill for three years. Began to have these symptoms after childbirth. Urine scanty, ℥xxiv in twenty-four hours. Normal, except a few hyaline casts.

Operation.—Jan. 4, 1899, I decapsulated the kidney, made multiple punctures in it, fastened it up, and removed a portion for examination. The immediate relief was astonishing to us all. Even the next day she declared that she was free from her old pain.

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5. THE JOURNAL A. M. A., March 11, 1899.

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Pathology.—Microscopic examination of kidney tissue revealed interstitial nephritis.

In 1900 she returned, complaining of pain in her pelvis, and through the vagina I removed a left ovarian cyst. At this time her urine was normal in quantity and quality, but occasionally, such as after a hard day's work, she had an aching feeling in her left side, for which electricity was used. I have heard from her repeatedly during the past year, and she is symptomatically cured, it now being over four years since the operation.

INTERSTITIAL NEPHRITIS (BRIGHT'S); RIGHT FLOATING KIDNEY. DECAPSULATION. NEPHROTOMY (DRAINAGE); NEPHRORRHAPHY.[6]

CASE 4.—*History.*—Mrs. W., aged 26; chronic pain over right kidney, which was freely movable. Was taking from two to eight grains of morphin per day for the pain. (See full report.[6]) Had two confinements, one miscarriage, pulmonary hemorrhage, trachelorrhaphy, chills and fever (supposed to be malaria), cholecystotomy.

Operation.—Finally I operated on her right, tender, floating kidney. Owing to the septic condition of her urine, I thought the kidney was septic also, but it was not.

Pathology.—Microscopic examination of kidney tissue revealed the unmistakable changes of interstitial nephritis.

The immediate result was admirable. The albumin and casts cleared away before she left the hospital. After the first three days after the operation, she did without morphin, even though a habitué. Two years later she was well, and a later report brings the same good news.

INTERSTITIAL NEPHRITIS; NEPHROTOMY AND DRAINAGE OF LEFT KIDNEY.

CASE 5.—*History.*—Mrs. H.; aged 32. From Livery City, Iowa. Complains of pain and tenderness in the region of left kidney, which began two years previously, and then lasted severely for twelve hours, and had bloody urine. During 1897 and 1898 she had several attacks of pain and tenderness, referred to her left kidney, sometimes passing blood in urine, and often accompanied with chills and fever. During the last six months the attacks were more frequent, but no blood was passed with the urine. Mild chills and feverish sensations accompanied nearly every attack. On going over the case thoroughly, a diagnosis of recurrent interstitial nephritis was made.

Operation.—Nephrotomy was performed March 16, 1899, and kidney drained for twelve days. Patient left the hospital after three or four weeks, with marked general improvement, and entirely relieved of her pain and tenderness over the kidney.

Pathology.—The microscope shows interstitial nephritis.

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6. THE JOURNAL A. M. A., March 11, 1899.

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INTERSTITIAL NEPHRITIS (LEFT). DECAPSULATION AND MULTIPLE PUNCTURES. GAUZE AND TUBE DRAINAGE TO KIDNEY.

CASE 6.—*History.*—Mrs. C., aged 43; dressmaker. In August, 1898, frequent urination; pain in back and over left kidney. Urine contained blood, albumin, casts; was highly colored and scanty, as reported by her attending physician at that time. Ever since this attack, kidney has been tender, but the urine has become abundant, three or four times the normal quantity, of low specific gravity (1,005), and always contained albumin and usually casts. Menstruation began at 14 and has been irregular. Edema of feet and hands; eyelids swollen and eyesight poor. Had pneumonia three times; inflammation of the bowels twelve years ago (probably appendicitis); abscess (1893) in pelvis opened into vagina; gonorrhea from her husband fourteen years ago (1885). Her mother died of ovarian tumor and interstitial nephritis. The region of the left kidney was tender.

Urine segregated, and that from the left side showed the following changes: "The specific gravity of both specimens is so low that I thought a mistake had been made, and we got water for examination. Doubting whether this was urine at all I tested for urea, and found 0.2 per cent. in both urines (should be 2 to 3 per cent.). There are some chlorids and phosphates, but the centrifuge shows no sediment of any kind, except a few squamous epithelial cells and oil globules in both specimens. No albumin; no sugar in either specimen. Reaction: Neutral in both specimens. No bacteria found in either urine. No casts." (Zeit.)

Pathology.—Report of kidney tissue: Interstitial nephritis.

Operation.—June 28, 1899. Left hospital in twenty-three days, improved in all her symptoms. In three months, urine much improved. Symptoms of nephritis almost absent. At the end of six months she resumed dressmaking. Her gain in general was slow, but gradual. During 1900 she had to cease working for a week out of every six or eight. In November, 1902, she was confined to bed for two weeks, and house for three weeks longer, with influenza. Both kidneys were sore and tender, but fortunately no active inflammation of them manifested itself. It was fully four months before she regained her usual health. Now she replied: "I am well; that is, much better than before the operation. I am working all the time, but have to be careful But I enjoy life. It makes me feel happy that for six months there has not been even a trace of albumin in my urine."

NEPHRITIS. DECAPSULATION.

CASE 7.—*History.*—Mrs. D., Redland, Iowa. Post-Graduate Hospital. Aged 34. Complains of: 1. Constant pain in the region of right kidney, with some pain in the left, off and on.

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2. Inability to work for the last two years. 3. Urine irregular in quantity. 4. Shooting pains into back and thigh. Pain often severe all night, and during the day it is increased on motion. 5. Is weak, dizzy, constipated, and is troubled with palpitation of the heart.

Had a child two years ago, and has not been well since then. When 15 years of age, was struck in the right inguinal region with a baseball, following which she had colicky pains in that region for some time. Family history negative. Urine too abundant, ℥cxvi in twenty-four hours, of low specific gravity, 1,005; a trace of albumin; no sugar; casts, granular, hyaline; and contained indican. A diagnosis of interstitial nephritis was made.

Operation.—Decapsulation of right kidney. At the end of the third week urine in quantity only ℥xlv in twenty-four hours, and much freer from casts. (Portion of kidney removed was lost in the operating room.)

The patient left the hospital on the twenty-third day, free from her painful symptoms. Recent report not given. A year after the operation she was symptomatically relieved, and felt that she was cured.

MOVABLE KIDNEY AND NEPHRITIS. DECAPSULATION; MULTIPLE PUNCTURES.

CASE 8.—*History.*—Mrs. J. E. B.; aged 45; married. Admitted May 7, 1901; discharged July 2, 1901. Housewife; Swedish. Diagnosis: Movable kidney and nephritis. Parents both died from some acute lung trouble at an advanced age. Has seven brothers and sisters living and well. Patient has always been well. Married at 39; no children; never pregnant.

Present Illness: About five years ago she noticed pain in the right side of the abdomen, above the crest of the ilium and in back. About one year later she discovered a lump in the right side. It was easily movable in any direction, the limit being the center of the abdomen, costal cartilages, and below to McBurney's point. Has no severe pains at this time. Has worn elastic bandage for some time. Was able, but with difficulty, to attend to her household duties. For the last six months a dull, aching pain in the region of kidney has been constant. Menses now regular and normal. Bowels constipated. Lost some weight.

Operation.—Placed patient in saddle, which brought the kidney well up to parietes. Incision four inches long. Stripped kidney of its capsule. Made multiple punctures and anchored as usual. Drainage of gauze in wound.

Urine examination: Before operation, specific gravity 1018; acid reaction; slight albumin; hyaline and epithelial casts; no sugar. Temperature before operation, 98 to normal; pulse before operation, 80. Temperature after operation, maximum, 101; pulse after operation, maximum, 110.

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Result: Dr. E. M. Brown saw the patient December, 1902. She was then entirely well.

PARENCHYMATOUS NEPHRITIS AND STONE. DECAPSULATION AND NEPHROTOMY.

CASE 9.—*History.*—Mr. F. R., aged 38, of Luther, Ind., entered the Post-Graduate Hospital June 26, 1901. Complained of (*a*) pain in left side, running down to the testicle; (*b*) attacks of sharp pains, laying him up; (*c*) urine scanty and high colored. He passed gravel a year ago, after an attack of renal colic; then got some relief. The last few months the attacks have been more frequent, and recently the pain in the region of the kidney has become constant. The urine contained pus, blood, casts, bacteria, albumin, increase of chlorids and some bile.

Operation.—Decapsulation was made, because the capsule was firmly adherent. Nephrotomy was then performed, and several small calculi removed. Removed a section of the kidney and drained the kidney with a tube. This tube was left *in situ* until the discharge was free from pus and germs. He made a good recovery, left the hospital July 19, 1901, free from pain and greatly improved in his general health.

Pathology.—The report of tissue by Zeit and Klebs was that of parenchymatous nephritis, with cloudy swelling, regenerated epithelium, with granular and epithelial casts in tubes.

Result: Both immediate and remote, excellent.

RIGHT FLOATING KIDNEY; SUBACUTE NEPHRITIS. DECAPSULATION AND NEPHRORRHAPHY.

CASE 10.—*History.*—Miss H., single, aged 32; musician; American. Admitted April 16, 1902. P. and S. clinic. Discharged May 18, 1902. Condition improved. Examined by Dr. E. M. Brown, March, 1903. Well.

Family history: Father and mother living and well. Four sisters and one brother living and well. One sister died during confinement.

Personal history: Diseases of childhood. Always well until ten years ago; began to get pale and weak. Exhausted on the least exertion, also very nervous. Bowels constipated. Appetite fair. Uncomfortable after eating. Began menstruating at the age of 13 years. Always regular, but painful. Eight years ago had dilatation and curettement for painful menstruation.

Present trouble: About eight years ago the patient had a fall from horse, since which time she has noticed a lump in right side of abdomen, which is very movable. Also complains of pain in right groin and appendiceal region. Tenderness of gall bladder also.

Urine examination; On admission, color amber. Specific

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gravity 1012: Reaction acid. Albumin none. Sugar none. Epithelial and granular casts. Urates and mucus.

Operation.—Usual kidney incision; kidney brought up and stripped; anchored to fascia. One strip of gauze for drainage. Appendix found suspicious and removed.

Pathology.—Microscopic examination showed slight change in interstitial tissue and parenchyma.

Temperature before operation, normal to 99. Pulse before operation, 76 to 90. Temperature after operation, maximum, 101.06. Pulse after operation, maximum, 112. Recovery uneventful.

DISPLACED AND FIXED KIDNEY. DECAPSULATION AND NEPHRORRHAPHY.

CASE 11.—*History.*—Mrs. B., of Ashkum, Ill, aged 33. Referred by Dr. Ernest. Entered Chicago Hospital complaining of (1) pain in abdomen, especially on the right side; extreme tenderness on pressure; (2) intense pain, as if on fire, which patient insisted was the case; (3) great weakness, loss of weight and strength; (4) mental and constitutional condition much deranged.

Very unsatisfactory history, except that symptoms began after an attack of measles, followed by typhoid in February last, since which time patient has been gradually growing worse. In bed and unable to rise for over three months.

Physical examination revealed a firm, movable tumor, of the shape of a kidney, on a level with the umbilicus on the right side. This could not be returned to the kidney fossa. Urine: Specific gravity 1014; urea, 2.2 per cent.; albumin, peptone, indican, pus, epithelia, cylindroids and phosphates all present. Feces: No pus or blood, very fetid. Blood: Hemoglobin, 45 per cent.; red corpuscles, 4,500,000; leucocytes, 11,000; no Widal reaction.

Operation.—April 22, 1902. Exploratory incision down on tumor, which proved to be the kidney. All the abdominal organs examined and found normal. Incision closed. Lumbar incision made and kidney drawn up into it. Kidney congested and capsule thick and firm. Capsule stripped off and section of it and kidney removed for examination. Kidney sutured in place and drained with gauze and incision partly closed. Patient transfused, 1,000 c.c. of normal salt solution on table.

After-treatment: Patient given normal salt, one pint per rectum, every four hours for several days, and liquids *ad lib.*, by mouth. Pulse 120 and irregular. Temperature 102.8. During first four days patient had involuntary bowel movements, after which she began to retain normal salt and rectal feeding. Wound received daily attention and was kept clean.

On the twelfth day temperature was normal and pulse stronger and regular. Patient was able to be up on the

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twenty-seventh day, and on the thirty-eighth day following operation was able to be taken home.

Pathology.—Specimen normal, except for a few inflammatory cells. Present condition, patient in good health and well. Remarks: I fail to see what my operation had to do with her recovery. A. H. F.

RIGHT FLOATING KIDNEY. DECAPSULATION AND NEPHRORRHAPHY. GALLSTONES. CHOLECYSTOTOMY.

CASE 12.—*History.*—C. Hosp. Dr. McKibbon, referred. Miss F., of Kalamazoo, Mich., aged 24; stenographer. Complains of (1) pain in right lumbar region, aggravated by exertion; (2) some swelling of ankles and of eyes; (3) headache and nervousness; (4) loss of appetite, constipation.

Illness began two years ago with pain in right side, which extends up to shoulder and down right leg. In February last it became worse and patient is now in almost constant pain. Urine: Specific gravity, 1024; no albumin nor casts. Epithelium (squamous).

Operation.—May 26, 1902. The kidney was found movable and prolapsed, and the gall bladder was palpable. Kidney decapsulated and punctured and sutured to lumbar wall. Gall bladder drained after removal of stones from it and the cystic duct.

Kidney was drained for two weeks. Patient had temperature of 100 till the eighth day, when it rose to 104. This was accompanied by great nausea and vomiting. Wound was dressed. Stomach washed out and patient given hypodermoclysis, a pint and a half of normal salt and a pint per rectum every four hours. Temperature dropped to normal in two days, and patient made a good recovery, leaving hospital on thirty-second day with small sinus, which soon closed. Now satisfactorily relieved.

PARENCHYMATOUS NEPHRITIS. DECAPSULATION OF BOTH KIDNEYS.

CASE 13.—*History.*—Mr. B., aged 37. Referred by Dr. Wm. E. Quine. Complains of (1) pain in both kidneys, greatest in right; (2) highly albuminous urine; (3) general anasarca and ascites, with pitting over tibia on pressure.

When attending college about seventeen years ago patient contracted syphilis, for which he was treated three years and declared cured. Three years ago came to Chicago, suffering from anasarca, ascites and albuminuria. His life was despaired of, but by mercurial inunctions all symptoms except albuminuria cleared up. Patient was sent to warm climate, where he improved rapidly, stopped the treatment, grew worse, and under doctor's instructions began treatment again. Improvement now was slow and unsatisfactory. Recently patient has not been so well and was referred for decapsulation.

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Right kidney is palpable and tender. Left kidney not palpable, but tender on pressing over it.

Urine: Twenty-four hours, ℥xxxii. Albuminous (50 per cent.). Granular casts in abundance. Pavement epithelia. Blood and bacteria present.

Operation.—Aug. 19, 1902. Right kidney exposed; the capsule, which was firm and adherent, was stripped off and the kidney punctured. Gauze drainage inserted down to kidney.

Patient made good recovery. Urine began to increase from the beginning, being ℥xli on the second day. The albumin likewise decreased, until on leaving on the eighteenth day there was only about one-half of 1 per cent. There was a slight fistula, which was rapidly closing.

Second Operation.—Patient returned Sept. 30 for operation on left kidney. Urine: Twenty-four hours, ℥xxxi. Albumin, 2¾ per cent. Casts: hyaline and granular. Left kidney drawn into wound and decapsulated. Drained down to kidney with plain gauze.

Patient made good recovery, leaving hospital on seventeenth day, with incision closed. Urine improved in quantity almost from the first day, the following being the daily quantities in ounces: 31, 31, 21, 32, 49, 53, 38, 58, 52, 66, 62, 82, 94, 65, 74. The albumin decreased to 0.15 per cent.

April 26, 1903. Mr. B. now reports that his general health is good and sends the following report of his urine: Twenty-four hours, ℥lxxxv; color, light amber; reaction, acid; specific gravity, 1015; albumin, 0.05 per cent. (by centrifuge); leucocytes, a few red cells, small, as if from the kidney. Renal cells, some fatty and a few fine and medium casts.

Pathology.—Microscope shows parenchymatous nephritis with hyaline degeneration.

FLOATING KIDNEY. DECAPSULATION AND FIXATION.

CASE 14.—*History.*—Miss B., Newport, Wis., aged 24, nurse. Complains of (1) severe pain in gall bladder, but no colic; (2) jaundice, which is sometimes marked; (3) pain in back, which radiates down the right iliac fossa and legs: (4) drowsiness; (5) puffiness of eyes and swelling of wrists and hands; (6) temperature, 99 to 101; (7) loss of weight; lassitude,

Urine normal. Has a soft, compressible tumor continuous with the liver, and another movable and firm, which can be replaced to kidney fossa. Patient had a severe attack of pain radiating down the right leg in September, 1900, and a second in March, 1901.

In August, 1902, pains returned in right side, and shortly after this she noticed jaundice for the first time. A second attack compelled her to stop work, and after a short time she returned for operation.

Operation.—Oct. 4, 1902. The gall bladder was drained. The kidney was decapsulated and punctured freely several

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times and drained; then sutured in place. Kidney drained for two weeks and closed. Patient made a good recovery.

Pathology.—Microscopic examination reveals, practically, a normal kidney; the slight cloudiness and congestion being due to the chloroform and manipulations.

Present condition: Free from symptoms. Urine normal. Has some pelvic pain at and following menstruation.

BRIGHT'S DISEASE AND PELVIC DISEASE. DECAPSULATION OF ONE KIDNEY AND LAPAROTOMY.

CASE 15.—*History.*—Mrs. J. C. W., Chicago, aged 41, housewife. Complains of (1) backache; (2) pain in left side in lumbar region, extending up into shoulder and down into leg; (3) burning pain in feet, with swelling; (4) pain in pelvis; (5) dysmenorrhea; (6) headache, nervousness, sleeplessness; (7) frequent micturition; (8) nausea and at times vomiting; (9) constipation; (10) belching of gas after meals, but has good appetite.

Symptoms began eight years ago with nervous prostration. Following recovery she had a pelvic abscess, which was drained. Had excellent health until about two years ago, when she was treated for uterine troubles. Gives no good history as to when her kidney trouble began, but bladder has given her trouble for four or five years. Her kidney is easily palpable in abdomen, and replaceable to kidney fossa. She has some uterine displacement and strong pelvic adhesions, involving the ovaries and tubes.

Urine: Quantity in twenty-four hours, ℥xxx; specific gravity, 1030. Strongly acid. Hyaline and granular casts. Epithelium, small, round, spindle and pavement. Red blood cells and leucocytes. Bacteria. Cylindroids. Uric acid. Calcium, oxalate and urates in heavy deposit.

Operation.—Dec. 4, 1902. Curettage. Freeing of pelvic adhesions. Removal of both tubes and part of each ovary. Kidney decapsulated, punctured, fixed and drained.

Patient's temperature for a week was from 101 to 102, and during the second week she was wandering mentally, but later became rational and made a good recovery, leaving the hospital on the twenty-ninth day. Kidney tissue changes are both interstitial and parenchymatous.

Present condition: Relief of all symptoms (except the bladder). Gaining rapidly in strength and weight.

RIGHT FLOATING KIDNEY. NEPHRALGIA. DECAPSULATION; NEPHRORRHAPHY; APPENDECTOMY. KIDNEY TISSUE NORMAL.

CASE 16.—*History.*—Miss H., Bradford, Ill., aged 24. (Dr. Hawkins.) 1. Burning pain in right kidney, with exacerbations. Pain radiating down in region of appendix, which region was also troubling her. 2. Pain over whole right side of abdomen and down the right thigh. 3. Inability to work.

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4. Loss of strength and confined to the house. 5. Attacks of pain in lumbar region, which would disable her for a week at a time, with frequent and painful urination.

Patient has been complaining about three years with symptoms referable to this kidney, and the pain in the region of the appendix was grafted on it in the last two months. Right kidney floating, enlarged and tender. Kidney could be pushed down into the iliac region. There was also tenderness over the appendix.

Urine: ℥xl, pale and clear. Specific gravity, 1007; neutral. Urea, .2 per cent. No albumin and no casts.

Operation.—Feb. 25, 1903. (1) Curettement and packing of uterus. (2) Appendix removed through kidney incision. (3) Kidney drawn up; decapsulated; capsule sutured to wall and incision closed.

Patient did well for three days following operation, when she had a slight rise in temperature to 99.6, and in pulse to 100, with pain in region of right ovary and tube, which spread over the whole abdomen. There was nausea and slight vomiting. Blood examination: 57,800 leucocytes, mostly polymorphonuclear form.

On the fifth day incision opened and gauze drainage inserted. There was no exudate, and there were no signs of infection.

Patient continued with signs of peritonitis, and died on March 9, just twelve days after operation.

Autopsy.—Peritoneal cavity had considerable fibrinous exudate. Kidney and wound normal. Cultures sterile. Appendix stump normal. Right tube slightly inflamed. Left tube and its region congested and inflamed. Cultures showed streptococcus. Descending colon as high as splenic flexure, and the sigmoid congested and inflamed, with fibrinous exudate. Cultures showed streptococcus infection. Death caused by streptococcus infection, probably an old infection of the left tube lighted up by the curettement, or by an infection following the curettement, which is doubtful.

CASE 17.—*History.*—Mrs. H., Chicago, aged 48. (Dr. Peacock.) In Chicago Hospital. Dr. Ferguson, consultant in operating room. Patient complains of (1) pain in the back, radiating down the right side and right thigh; (2) no urinary control; up several times at night and during the day; (3) pain in right iliac fossa.

Previous history: Ten years ago patient had ovaries removed. The commencement of pain is very indefinite, but it became quite severe during the last year.

The kidney is freely movable and very tender. Urine: Specific gravity, 1020; acid; urea, 1.5; hyaline and granular casts; small round epithelium. Considerable blood.

Operation.—March 20, 1903. Appendectomy by Dr. Peacock.

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Kidney decapsulated and punctured. Sutured in position. Gauze drainage inserted down to kidney. Incision closed. Patient made good recovery, leaving the hospital on the nineteenth day.

Present condition: Patient up and around the house. Relieved of all symptoms. Does not have to get up during the night, and urinates about every four hours during the day.

OBSERVATIONS.

For a synopsis of the histories of the foregoing cases I am indebted to my first assistant, Dr. Hugh Neil MacKechnie, and my associate, Dr. E. M. Brown. It will be observed that my personal experience dates back to 1889. In 1896 a nephritis in a floating kidney was deliberately treated by decapsulation, but not until Jan. 4, 1899, did I begin to remove sections of the diseased kidneys under treatment, and study them under the microscope. While the reports given above are incomplete, from lack of space, still it will be seen that our treatment was justified by the results. In the vast majority of my cases the kidneys were movable and also chronically inflamed. In only two cases was decapsulation carried out for parenchymatous nephritis. The results so far have been excellent and astonishingly prompt. The symptoms of the cases, regarding urinary changes, digestive disturbance, nervous phenomena, skin signs, circulatory and respiratory changes were recognized as not of the severest types of nephritis.

I did not operate on cases with urine extremely scant, very marked hypertrophy of the left ventricle of the heart, edema of the glottis and lungs, Cheyne-Stokes breathing, marked general anasarca, etc., etc. The urinary changes can not be absolutely depended on to indicate the tissue changes taking place in the kidneys until at least a late stage has arrived. It was noticed that a tender kidney is often relieved after its fellow has been decapsulated.

PATHOLOGY.

The pathology, macroscopically observed and handled on the operating table, and a study of the microscopic

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condition of the organ in a living patient are of superlative interest and importance. An enlarged kidney may have few or no histologic changes, while one normal in size is often surprisingly diseased. A contracted kidney is usually very much destroyed. The intimate relationship between the capsule and cortex of the kidney by adhesions does not give us an accurate idea of the extent of the inflammation. Neither does the appearance of the fatty capsule. The only scientific procedure to pursue to obtain anything like an accurate knowledge of the *status presens* of a kidney under operation is to remove a V-shaped piece of the cortical and pyramidal tissues and study it microscopically.

MICROSCOPIC OBSERVATIONS.

In ten of the seventeen cases a portion of kidney was examined and studied. There were no pronounced changes in three. The pain and tenderness in these three cases of floating kidney must have been caused by something else than inflammation. In five instances the interstitial form of the disease was demonstrated by the microscope, which in these verified the clinical or provisional diagnosis. The microphotographs prepared by Professor Zeit reveal a picture of chronic interstitial nephritis. The proliferation and hyperplasia of connective tissue and areas entirely connective tissue, with obliterated or waxy glomeruli. One also sees islands of partially changed kidney tissue, with atrophic tubules, and tubules with desquamated epithelium; flattened epithelial lining in tubules of diminished caliber and some swelling in the lining of the epithelial cells. The hyaline casts in the tubules are worthy of notice, as are also the thickened capsules of glomeruli and the concentric layers of connective tissue with many nuclei, etc.

OPERATION.

(*A*) *Superficial Oblique Incision.*—Make the skin incision a finger's breadth below the twelfth rib and

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parallel to it. Cut down to muscular tissue; then dissect the skin and fat from the muscles downwards to the crest of the ilium.

(*B*) *Deep Vertical Incision.*—Go through the rest of the structures as if to remove the kidney through the lumbar route, along the outer border of the quadratus lumborum. In cutting the lumbar fascia, keep well backwards.

(*C*) *Fat.*—On exposing the fat do not tear and traumatize it, as is so often done, but carefully cut with the knife its thin fibrous covering. Do not insert the hand to pull at the fat, but seize hold of it with many pressure forceps and deliver it externally. It will now be found that the kidney is immediately beneath your fingers in the wound.

(*D*)*Delivering the Kidney.*—Do not use the hand to deliver the kidney. Firm pressure on the abdomen and traction made on eight or ten forceps applied to the fat, close to the kidney, will easily bring a movable kidney outside the wound. In some few instances the renal vessels are too short to allow the kidney to be delivered at all. Indeed, it is not necessary to have the kidney dragged out in order to decapsulate it, but if it comes out easily, I do it. When the kidney is situated rather high, and the traction on the forceps does not promptly bring it down, I find a long narrow retractor, with a slight concavity outwards, passed beyond the upper pole, greatly facilitates its delivery.

Splitting and Peeling the Capsule Off.—Incise the capsule longitudinally over the vertex of the kidney for about two-thirds its length, peel it from the cortex with the handle of the knife or finger until it is entirely separated, then slip one end of the kidney through the slit in the capsule, and then the other, and it will be seen that it forms a collar around the hilum of the kidney. If the kidney is movable, I utilize the capsule to suture it in place, and the organ is left in contact with raw muscular tissue which is more vascular than the

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fatty capsule and is, therefore, a more suitable structure to form vascular adhesions with the denuded organ.

Disposal of the Perirenal Fat.—Do not remove it or tear it to pieces, but gently displace it to the lower end of the kidney. It is but poorly supplied with blood vessels, therefore as little of the surface of the kidney as possible is left in contact with it, but when placed it furnishes an additional support to the organ.

Puncturing the Kidney.—In most of my cases I have freely punctured the cortex of the kidney in many places. This not only furnishes free drainage for inflammatory products, but also insures a thorough determination of blood to the parts, which hastens resolution and favors repair. It must also be remembered that the fibrous tissue formed for the purpose of repair in the absence of pyogenic organisms has a tendency later on to clear away rather than increase in bulk, and subsequently contract and become cicatricial. Of this we see many instances in surgery.

Drainage.—Drainage should always be established for five to eight days after decorticating the kidney. My experience leads me to use plain gauze and a small rubber tube for this purpose. It is astonishing the quantity of blood serum and urine that saturates the dressing for a couple of days. When drainage ceases remove the tube, and afterwards withdraw the gauze as it becomes loose.

Closing the Wound.—Use small-sized catgut to coapt the muscles and silkworm gut for the skin, the drainage tube and gauze emerging from the outer angle of the wound. After applying the dressing, place a firm pad of gauze or cotton on the abdomen below the ribs whenever nephrorrhaphy has been necessary.

HOW IS A CURE EFFECTED?

This has not yet been fully worked out. It is my opinion that the excellent immediate results are due to the relief of kidney tension and that the permanent

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benefit accrues in the cases demanding it from the establishment of collateral circulation with the diseased cortex. There are many instances of the formation of vascular adhesions in different parts of the body to support this latter fact.

EXPERIMENTS.

Before experiments on animals can throw any light on this subject we must first produce nephritis in them. In the production of this all efforts have been unsuccessful. I notice in the *Annals of Surgery,* April, 1903, Dr. H. A. Johnson writes on "Results of Decapsulation of the Kidney," being work done on dogs. He operated on 15 dogs; 5 died in from three hours to three days after the operation. The animals surviving the operation were killed. "Changes were studied two, four and eight days; two, three and four weeks; two and two and one-half months." The chief observation in his article is the eighth, viz., "In no case was there any considerable anastomosis between the renal and perirenal blood channels." It must be observed that in these experiments the kidneys of the dogs were normal and did not require additional blood channels for physiologic purposes, and also the organs were returned within the fatty capsule, which is but sparsely supplied with blood vessels.

In conclusion, I have no hesitation in affirming that decapsulation of the kidney in acute, subacute and chronic nephritis, both interstitial and parenchymatous, is a practical and effectual surgical procedure. Its limitations are not yet determined. While it can be pointed out that regeneration of kidney tissue is possible, it is folly to claim this procedure to be a panacea for Bright's disease.

10 Drexel Square.

DISCUSSION

ON PAPERS OF DRS. WHITACRE, GUTHRIE AND FERGUSON.

DR. ARTHUR DEAN BEVAN, Chicago—The treatment of suppression of the urine is a subject to which my attention has recently been called by a number of cases, and one which I do

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not believe has been very well worked up by the profession. Recently I presented to the Chicago Surgical Society a case of anuria treated by surgical interference, and I found that the great majority of the members had not dealt in this manner with any case of anuria. This was my first case, the subject was rather new to me, and it gave me an opportunity to investigate it with some care. I came to the conclusion that the method had not been sufficiently emphasized and felt that the disease should be treated as a surgical entity. I attempted to make a clinical classification which would enable us at the bedside to determine on what line we should work in order to aid the patient. The classification which I decided on was as follows: 1, Obstructive anuria; 2, reflex anuria; 3, nephritic anuria.

The reflex condition, of course, is the one which is the most common and which gives the best prospects for relief under surgical interference. The reflex anuria, I came to the conclusion from the study of the cases, was a rather rare condition, although from the work of Getzel, the assistant of Israel, there can be but little doubt that such a condition does exist. Getzel's experiments, by increasing the renal tension, show that it would decrease the quantity of urine, in either or both kidneys, according to the application of the pressure, and when the tension was increased to a certain point in both kidneys, there would be entire suppression of the urine. Of course, in case of hydronephrosis on one side, fixture of the hydronephritic sac has been followed by relief of the anuria. The case presented by Dr. Whitacre, I think, comes under the nephritic group. Since reading this paper before the Chicago Surgical Society I have had an opportunity of doing a nephrectomy under nitrous oxid gas. The operation can be done in from five to eight minutes, during which time you can easily keep up the anesthesia, and this kind of anesthetic is especially valuable, as we are never sure of diagnosis until we make an exploratory operation. It may be a case of nephritic anuria; it may be a case of the obstructive variety, or there may be a stone in the kidney. A nephrectomy gives an opportunity of exploring the pelvis and relieving any abnormal condition which may be a cause of the anuria. I should throw out of consideration the decapsulation of the kidney for anuria and would say that the operation of choice was a nephrectomy under an anesthetic which could do no danger to the kidney tissue, such as nitrous oxid gas or infiltration anesthesia.

Dr. Wm. Jepson, Sioux City, Iowa—It is hard for us to say, with our present knowledge, of just what value decapsulation of the kidney may be. One of the papers deals with the topic of who was the originator of the treatment by decapsulation; I know that Edebohls was not the originator, because we know that Redner did this operation in 1892 at the

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suggestion of Professor White, and he reported a number of cases before the British Surgical Association in 1898, in which he had this topic under consideration. In 1899 Israel reported 19 cases. So that I think we are safe in stating that Dr. Edebohls was not the originator of this method. Harrison reported 6 of these operations in 1896, and called attention to this method of stripping off the capsule in order to relieve the tension, and then, in addition, there were the cases of Professor Israel. Babinsky carried out these observations, and his work was proven by the fact that he removed sections of the kidney in order to determine just what the lesion was. Therefore, in cases of chronic nephritis we can hope for very little benefit from stripping of the capsule, but it is in those cases where we have an interstitial nephritis with an involvement of the surrounding structure and thickening of the capsule, and especially where we have a hemorrhage under the capsule, that this method will do the greatest amount of good. On the other hand, you will remember that Edebohls concedes the idea that by separating the capsule from the kidney it produces a restitution in the normal functions, even to the extent that the whole tubules have radically become regenerated. Now, with such opposing views, should we not be very careful and considerate as to whether these operations do or do not do the kidneys good? I am sure that we have all observed that marked benefit would follow an operation which was primarily undertaken as an exploratory operation. I think probably splitting of the capsule or of the kidney produces this change.

Dr. Archibald McLaren, St. Paul, Minn.—I wish to emphasize the point made by both Drs. Bevan and Jepson, namely, that the advantage which we sometimes get in these cases of painful and uncomfortable kidneys, is often due to the splitting of the capsule, without the decapsulation. There are not many of us who are ready to recommend stripping the capsule in chronic nephritis as yet. We may later come to believe that this is the proper procedure. I can remember a number of cases where the conditions found were inexplicable with the results produced by merely splitting of the capsule, such as relief from the pain, disappearance of the albumin, etc., and many of these cases got considerable permanent relief. I have seen a few cases that have been decapsulated; although they received some immediate benefit, this improvment did not last long.

Dr. Richard H. Gibbons, Scranton, Pa.—The first man in all the world to recommend surgical interference for the cure of Bright's disease was Edebohls. All the others who did the operation did it incidentally, just as Dr. Ferguson did. They did not do the operation for the relief of Bright's disease; they did the operation for tension or some other cause which

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they supposed existed, but which they did not find when they operated. It was for this same reason that Israel did the exploratory operation and split the capsule, but Edebohls not only split the capsule, but he entirely decorticated the kidney; not only one kidney, but both kidneys, and afterward found that the condition could be relieved by surgery, and there is no man to whom credit for this work more justly belongs than to Edebohls, as he came out and recommended it for the condition, and would have had to have accepted his share of the damnation had it proved a failure. I believe so much in this method of splitting the capsule and detaching it in chronic Bright's disease as to have done the operation on my own sister, and at the same time I took out her appendix. I have had a number of cases of Bright's disease recover by this treatment, and many of them have been cases which have been proved to be this disease by the subsequent examinations of one of the best pathologists in Philadelphia. I had a case recently where I detached the capsule, and in which there was a number of multiple cysts in both kidneys, and the patient got well. Only four weeks ago to-day I operated on a young lady with a retroverted uterus, loose appendix and diseased kidney on the right side. She had all the symptoms of appendicitis, the diagnosis having been confirmed by Dr. Brooks of the Post-Graduate Hospital, New York. I referred her to Edebohls, as I hesitated to advise an operation without her seeing him. He recommended operation with fixation and decortication, which was almost entirely what I had recommended. She left the hospital last Sunday; her symptoms were improved in every way and the albumin in the urine very much diminished. Another case in relation to Dr. Whitacre's paper was a young woman on whom six weeks before I had operated for appendicitis, and expected to fasten a loose right kidney. I found a number of abdominal adhesions and decided to take out the appendix anteriorly. She got no relief and showed the usual symptoms of appendicitis and loose kidney. I operated on her several months afterward and fixed the right kidney, but did not touch the left kidney. She had all the symptoms of chronic Bright's disease, as proven by Dr. Brooks' examination. She immediately went into a state of surgical anuria. She died the latter part of the sixth day from complete suppression of urine, having passed six ounces up to that time. If I had only opened that woman on the left side, exposed her left kidney and decorticated it, the probabilities are that she would not have died from that condition.

Dr. Ramon Guiteras, New York—I think that the operation for chronic Bright's disease is still in its infancy, and it behooves us all to work with the object of improving our technic and bringing this operation to a position where it will be generally accepted by the profession.

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Last year I read a paper before the American Genito-Urinary Association at Atlantic City, which was a preliminary report on this subject, and next week I am about to present a similar paper before the Congress of American Physicians and Surgeons in Washington. As there are so many varying opinions as to the advisability of attempting such an operative procedure, I have written to 150 of the most prominent surgeons in this country, and have mailed them circular letters covering the most important points connected with the operation, and have been very much pleased to find how many of them have responded to my letters. The opinions of these gentlemen, however, vary much. Some condemn it as an operation having no surgical or pathologic *raison d'etre*, while others reply at length, describing their experiences in a most enthusiastic manner.

Of course, as you know, the object of decapsulation of the kidney in this operation is to increase its circulation. Some of the leading medical men have likened the kidney after this procedure to the lung where there is a double circulation, the bronchial fortifying the pulmonary system. Dr. Johnson of San Francisco, in order to test the truth of this assertion, operated on a number of dogs in which he decapsulated the kidney for the purpose of investigation. He states that the blood supply is but slightly increased, if any, and a new capsule forms which in time becomes thicker and denser than that of the original one. It would take too much time to consider the question of Bright's disease, but as you know it is a disease of the kidney where either the connective tissue, the blood vessels, the Malpighian tufts or the tubules must be involved. Bad cases of Bright's disease very often show very little in the urine, while cases of transient albuminuria and cylinduria are often seen where no pathologic changes have occurred in the organ, although such changes will occur if the cause of the transient trouble is not corrected. These latter cases, we believe, are benefited or permanently cured by the operation mentioned.

Considerable has been said of late concerning unilateral Bright's disease, and some have spoken of this disease as present at times in only one kidney, or its being more marked in one kidney than in the other. It is a very difficult thing, it appears to me, on exposing the kidneys to say this kidney has nephritis and the other one has not, or this has nephritis to a greater or less extent than the other. Such fine discernment from a gross pathologic standpoint from viewing the outside of the organ when the capsule has been stripped off is, to my mind, next to impossible. In order to investigate the subject of unilateral nephritis I had the autopsy records of 500 cases of deaths from chronic Bright's disease looked over, and in only one case did I find the record of a purely unilateral

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affection, and this one, to my mind, could not be relied on. In only 14 cases out of the 500 did the records show that one kidney was more involved than the other. In nearly every case a very careful pathologic examination was made after removal of the organ.

DR. L. L. MCARTHUR, Chicago—Last year I undertook the relief of a chronic interstitial nephritis in the case of a young woman referred to me by members of this Society, Dr. Favill of Chicago and Dr. Norman Bridge of Los Angeles, who for six months had had the patient under treatment, and finding her but slightly benefited by medical assistance, treatment, change of climate, etc., had recommended removal of the capsules of her kidneys and requested me to do it.

I had little confidence in any good that might arise from the operation, but agreed to it because of the reports contained in the literature. Before the operation, I took pains, in addition to the examinations which they had made, to make a separate collection of the urines from both kidneys at three successive times for three successive weeks. The urine, when microscopically and chemically examined, showed the presence of Bright's disease equally affecting both kidneys. I then said that I would decorticate one kidney to see whether that kidney would be benefited as compared with the other. I did so. The quantity and quality of the urine from the operated kidney was very much increased and improved as compared with the other kidney. The patient improved physically; in fact, she was so much better that in the course of about three months she came back and urged the decortication of the capsule of the other kidney. Her condition physically was better; the edema of the eyelids had disappeared and the face assumed a more normal color.

I removed the capsule of the opposite kidney and its urine soon assumed as good a condition as that from the other kidney. Segregation was made in order to determine whether there was improvement or not.

There is surely some value in this operation, although just what the value of it may eventually be remains for time to tell. I do not think it is going to be good for every case of chronic or acute Bright's disease; we must yet learn to pick out the cases which will be benefited, and I would like to say further, in regard to Dr. Whitacre's case, that I think it is a mistake to cut away the capsule, since by a little procedure the capsule can be preserved and will make a good platform for the fixation of the kidney. This consists in making a transverse equatorial incision on the posterior aspect of the kidney, loosening the capsule first of one-half then of the other; when loosened the poles of the kidney can be delivered, leaving the empty capsule in one piece in front of the kidney. This can then be used to suture to those structures to which the

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movable kidney is usually fixed by a nephropexy. A detailed report of this case will be published later.

Dr. F. A. Dunsmoor, Minneapolis—One thing has not been said here to-day in the papers read. Experiments were made ten years ago by Dr. Wyman of Detroit, to demonstrate the production of Bright's disease in dogs by temporary ligation of renal vessels associated with stripping of the capsule, half of the method now used for a cure. In regard to the case of anuria, I agree with Dr. Bevan that many of the cases of post-operative anuria are due to the anesthetic, as the operations were made with perfectly aseptic methods and, therefore, it would seem that this could be the only cause for the anuria. I also wish to agree with him and with the last speaker that it is not necessary to strip the capsule completely, since the incision relieves the tension.

Dr. Randolph Winslow, Baltimore—I wish to mention a case under my care, which is somewhat different from those that have been mentioned, but which, nevertheless, is in the same line. A young woman who had been confined in the central portion of North Carolina, was evidently in a thoroughly septic condition in consequence of that procedure. After many weeks, her condition having become so bad that her life was despaired of, she was sent to Baltimore. She came practically on a litter, and it was feared she would die before she could get into the hospital. She did not improve on medical treatment; there was pain over the right kidney and pus in her urine with a septic temperature chart. She was subjected to a cystoscopic examination, without determining anything in particular and, owing to the fact that she had pain over the right kidney, it was thought that there was some trouble with that organ. The kidney was exposed and apparently there was no abscess connected with it. I presume there was some pyelitis. There was nothing which, in my opinion at the time, justified either removal of the organ or nephrotomy. I punctured the kidney in a number of places and then stripped the capsule from it. The patient improved rapidly. The pus disappeared from the urine and in a very short time she was sufficiently well to go home, and continued well when last heard from.

Dr. H. J. Whitacre, Cincinnati—In reference to the classification suggested by Dr. Bevan: First, I did not have the pleasure of reading this valuable article until mine had been completed, and, second, had I read the article I would not have pain and tension, but later comes a stage where there is no followed the classification. My experience in this condition leads me to believe that this classification is incorrect. Dr. Bevan has given his classification into the obstructive, the reflex and the nephritic forms. One object of my paper was to present serious objections to the inclusion of obstructive

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lesions under the heading of suppression of urine. I do not believe that this form belongs under the heading of suppression of urine at all, no more, indeed, than does retention of urine.

I wish to likewise make objection to his second and third forms. True suppression of urine always concerns the parenchyma of the kidney, therefore all forms must be nephritic and a reflex suppression must likewise be a nephritic form. The classification which I have presented includes these two forms and more too. In all cases of true suppression of urine the parenchyma of the kidney is at fault. This may be a reflex fault, a degenerative lesion, the result of lessened heart action, the result of an anesthetic, or the direct result of trauma. Objection has been made in the discussion to the operative treatment of suppression of urine as irrational and improper. It was impossible for me to read my entire paper. It will be found, however, in the complete paper that such is by no means advised for all forms of suppression of urine. It is by no means advised that a degenerative lesion be submitted to operation, but that every possible agent be employed to improve the nutrition of the degenerated cells and to improve the flow of good blood to them. Nobody would think of treating a suppression of urine which occurs in shock from lowered blood pressure by administering an additional shock. Suppression from trauma could not be improved by adding another trauma. It is the purpose of the paper to classify the etiologic factors present and to show that operative treatment by decapsulation is not only rational, but actually demanded in those cases of suppression of urine that result from a reflex circulatory or vasomotor disturbance in the kidney. My reasons for recommending this treatment have already been given in that section of my paper which deals with the pathology.

Dr. Bevan has recommended nephrotomy as a more rational operation. It seems to me that a nephrotomy would not meet the indications, unless it split the kidney from end to end. The tension is exerting its deleterious influence on every cubic mm. of kidney parenchyma, and a single short incision would relieve the tension over only a very limited area. I do not see the advantage of opening the pelvis of the kidney. it is not at fault at all. I should most unhesitatingly recommend such procedure when there is reason to suspect a calculus in the pelvis.

Dr. McArthur has recommended that only an equatorial segment of capsule be removed, or, if the entire capsule has been stripped off, that this be turned back under the kidney and used to anchor it. I think that I caused a kink in the ureter of a floating kidney by doing this very thing.

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I have done decapsulation for Bright's disease once on the large white type of kidney. The results were not satisfactory, however, and I felt at the time of the operation that the operative procedure was in reality not relieving his kidney very much. I do not believe that this type of kidney will yield good results by this method.

DR. ALEX. H. FERGUSON, Chicago—I think there are one or two points in regard to the operation that ought to be made a little clearer. When the kidney is exposed the fat ought not to be taken away, but left displaced below it. The sudden effect which this operation has on the urine and the symptoms of the disease is simply marvelous. They are usually better even the next day, and the old pain is gone, and the albuminuria and the casts decrease within a couple of weeks. But how is this effected? That is the question that concerns us. First probably by relief of the tension. That would pertain to those cases in which there was intracapsular tension, such as would be produced by acute inflammation, like those cases of Reginald Harrison. In all the acute and subacute cases there is pain and tension, but later comes a stage where there is no tension, but just the reverse, a contracted kidney. There are various stages of contracted kidney that are more or less benefited by decapsulation. How does this come about? By collateral circulation, I think. Now experiments have been performed on dogs by Johnson of San Francisco, and in no case, he states, was there any considerable anastomosis established between the renal and perirenal blood channels. He returned the kidney back into the fatty capsule, where there would not be much attachment of a vascular nature seen. Experiments on dogs with normal kidneys do not bring the results that operations on a person who is suffering from nephritis do. I had a patient who came to me suffering from an infection of the kidney. I opened the kidney and the wound closed rather too soon, and the patient went home; the pain returned and she came back. I then opened the kidney again and removed a portion of the organ. There was a vascular connection formed between the kidney and the pseudocapsule.

In regard to this claim to priority, I do not wish to be misunderstood. But when a certain man does certain work and publishes it, not in an obscure medical journal, but in THE JOURNAL of the American Medical Association, on a certain date, and another man does certain work along the same line and publishes the result of his labors one month and eleven days afterward, it would seem that the first author should be the one entitled to first credit. But that does not matter very much.

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INDICATIONS FOR CHOLECYSTECTOMY.

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OMAHA.

The primary object of every surgical operation is to secure the completest and quickest relief compatible with safety. If it can be shown that in certain specified conditions of the gall bladder cholecystectomy is followed by more perfect restoration to ideal health, by a prompter convalescence, and that the mortality is no greater than in cholecystostomy, my point is made.

Cholecystostomy is frequently disappointing, the hoped-for benefits are only partially realized and the patient still has pain. Of my last twenty-eight cholecystostomies, six are known to have pain, not so severe as before the operation, but enough to be a source of worry and inconvenience. This means more than 20 per cent. of failures to accomplish fully what was attempted. Hans Kehr reports that in more than 17 per cent. of his cholecystostomies the relief was only partial. Others report the same disappointing results.

When we face squarely the fact that in any operative procedure there is to be considered not only the primary mortality but also the knowledge that about one patient out of five will be only partially relieved, some of them indeed almost as great sufferers as before, it is a humiliation to surgical pride. If improvement in technic will not give better results, no true surgeon will be satisfied until some other measure is found more satisfactory, really curative.

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A prolonged convalescence, though not an insuperable objection to an operative procedure, if finally followed by entire relief, is to be deplored. After draining the gall bladder till the infection is removed the fistula quickly closes in many cases, but in a startling number a chronic fistula follows, most of them finally healing, but after so long and disagreeable delay that many times the patient regrets ever having the operation. In the twenty-eight cases of drainage mentioned three fistulæ discharged for many months, but finally healed; one is still discharging after six months, and three continued to discharge until cholecystectomy was done. Twenty-five per cent. of chronic fistulæ seems a good many, but it occurred in this series and, judging from the number of fistulæ I have seen after operations by other surgeons, the conclusion can not be dodged that this is a standing opprobium to this form of operation.

In simple uncomplicated cases the operative mortality for cholecystostomy ought to be very low. Kehr gives his as 2 per cent. In the cases complicated by dense adhesions, atrophy of the gall bladder, acute infections and the like, the mortality is considerable. Kehr admits a mortality of 47 per cent. in this class of cases. Some of his cases were operated on a number of years ago. With the present perfected technic it is probable that it would be considerably less, though bound always to be high. The fact can not be evaded that with the serious complications met in all old cases and in the acute infections (empyemas, gangrene, etc.), the dangers from any operation are great, and in many we must be satisfied to do what will tide the patient over until in such condition as to be able to withstand such an operation as will bring relief.

Kehr has found that less than 1 per cent. of his cholecystectomies continued to have symptoms. All the rest were completely cured. Absence of all disagreeable sensations has been noted in all of my cases in which cholecystectomy has been done, though in two of them

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still under treatment it is too early to know the result.

After cholecystectomy the convalescence is very rapid. As a rule there is no discharge, though in occasional cases where infection of the ducts is present, closure of the cystic duct has not been deemed advisable. Even in cases drained in this manner healing has been prompt. No mucous fistula due to a diseased gall bladder poorly drained has been present. In ten out of twelve cases the wound has been closed in a week to ten days.

Kehr's operative mortality for cholecystectomy is 3.3 per cent., as against 2 per cent. for uncomplicated cholecystostomies. There is abundant reason to believe that many of his cholecystectomies would be considered complicated, so this seems an excellent showing for cholecystectomy. In my own cases since Jan. 1, 1902, there have been twelve uncomplicated cholecystostomies, with no deaths; sixteen complicated cholecystostomies, with three deaths (one of these I feel certain would have recovered had cholecystectomy been done); twelve cholecystectomies, with one death, a very badly complicated case.

Why are so many cases uncured after cholecystostomy? The answer to this question I believe to be found in the amount of pathology left behind. Adhesions to the pylorus cause dragging on the stomach, with resulting gastric symptoms. Adhesions to the intestines produce painful sensations during active peristalsis. There are often a number of conditions of the gall bladder following cholecystostomy, which seriously interfere with perfect emptying of the viscus: 1, Adhesions to neighboring viscera; 2, crippling of the gall bladder from inelasticity of its walls; 3, partial occlusion of the cystic duct; 4, interference with the perfect contraction of the walls during the effort to empty itself, due to the fundus being fixed to the anterior abdominal wall; 5, the weight of the liver pressing down on the anchored gall bladder.

The number of cases demanding surgery of the gall bladder in which the cystic duct is normal and in which

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the mucous membrane is intact and the walls normally elastic, is only a small minority. Such cases will usually close promptly after simple drainage. But when any of the above conditions are present, prolonged and imperfect convalescence is to be expected.

The advantages of cholecystectomy are to be found in all the conditions which render cholecystostomy unsatisfactory and disappointing: 1, When the cystic duct is wholly or partially occluded healing is prompt and complete; 2, when the wall of the gall bladder is thickened, friable and atrophied, the functionless viscus is taken out and can no longer torment the patient; 3, when there are adhesions they will remain as long as a pathologic gall bladder is present to keep up the irritation; 4, it is a well-known fact that intra-abdominal adhesions gradually weaken, stretch and disappear when there is no disturbing element; 5, the value of the gall bladder as a reservoir for the bile is *nil,* and functionally it serves no more useful purpose than does the vermiform appendix; 6, after a gall bladder has been as profoundly diseased as it usually is when made the object of surgical attack it never regains its normal state and is henceforth not only valueless but, on account of its defective drainage, is constantly subjected to the risks of fresh infection; 7, the cholesterin, which is the principal element of almost all stones, is only elaborated in such a quantity as to do harm by the epithelium of the gall bladder when infected, being due to degeneration, therefore, when removed, all danger of future stone formation is at an end; 8, it is estimated that at least 5 per cent. (Mayo) of the cases of serious disease of the gall bladder are followed eventually by carcinoma; removal will take away this menace.

A number of gentlemen who have written on this subject seem to regard cholecystectomy as especially dangerous where adhesions are numerous. Some of the most satisfactory results I have obtained have been in

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this class of cases and, as all know, adhesions are inimical to complete relief when cholecystostomy is performed. A gangrenous gall bladder is safer outside the abdomen, and, even though the operation requires a little longer time than simple drainage, I believe the risks of a slightly longer operation are more than offset by the more favorable condition following complete removal. When the operation is for empyema, more or less destruction of the mucous membrane of the gall bladder and cystic duct is to be expected and retention of such a viscus will probably result in only partial relief.

It must be admitted that there are some conditions where the simplest and quickest surgical procedure possible to give temporary relief is as much as the patient can bear. Here simple drainage may be done, to be followed later by cholecystectomy if complete relief is not obtained. In cases where there is temporary or permanent closure of the common duct this operation is, of course, not to be thought of.

To some the existence of infection has been deemed a contraindication to cholecystectomy, since it is in violation of the cardinal principle in these cases, drainage. It is as easy to secure drainage when the gall bladder is removed as when it is retained. In four of my cholecystectomies, instead of ligating the cystic duct, W. J. Mayo's method of removing the mucous membrane has been used. The greater part of the gall bladder is removed. Beginning a short distance above the cystic duct the mucous membrane is stripped off and removed down into the duct. Then a purse-string suture is introduced around the cuff of muscle and peritoneum and tied over the end of the drainage tube. It drains as perfectly as when the entire organ is retained, and closes quickly when the drainage tube is removed.

When the common duct is patulous and is not constantly being infected afresh from a septic gall bladder it seldom needs external drainage. The voluminous

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flow of bile through the hepatic and common ducts tends to sweep infective material into the bowel. The need of drainage in these cases is usually not to be found in the ducts but in the infected and crippled gall bladder. Surgeons who have once tried cholecystectomy are constantly resorting to it for an increasing number of indications. The operative mortality, immediate and remote, seems no greater than that from cholecystostomy when both complicated and uncomplicated cases are taken into consideration. The rapidity of convalescence is certainly a powerful argument in favor of the more radical procedure. The strongest inducement in favor of cholecystectomy is the complete relief it gives, in striking contrast to the painful and dragging symptoms which so frequently remain after cholecystostomy.

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THE CALL FOR EXPLORATORY OPERATION IN THE GALL-BLADDER REGION.

F. A. DUNSMOOR, M.D.
MINNEAPOLIS.

The surgical age is on, and it is to the credit of the profession that this is true. It were trite to cite cures where drugs have been used to worse than waste precious time, followed by an operation which has brought relief, comfort and usefulness to patients who were a burden to themselves and friends. It is not our intention to criticise former practice of the internalists or surgeons. It is not ages ago that each was barbarous in both senses of the word. It is an old tale to this body to be told of the safety of abdominal incisions when absolute cleanliness and skill attend the operation. Hence this word as advocating such procedure as a simple means of diagnosis and a long step toward the best method of cure.

The diagnostician has continually in his mind's eye a map of the surface of the body, and knows what normally should be hidden beneath each square inch thereof, irrespective of the attitude, posture or part presenting. He reviews the physiologic functions and possible or probable pathologic lesions, and still may have another guess coming. Nevertheless, a writer for one of our medical journals has said that no man should make an abdominal section until competent to certainly foretell the exact pathologic condition for which the operation was to be made. Mindful of this demand by critics, the writer hesitated to advance the suggestions of this essay.

Dividing the abdominal cavity equally into two zones, the upper will always be the field of most difficult sur-

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gical maneuvers, whose tumors are more frequently malignant and their cure impossible; while the lower provides the opportunities for brilliant recoveries to the beginner. This truism is magnified in the right hypochondrium, because of the important glands, ducts and vessels therein contained.

Neoplasms or inflammatory products in the pelvis have fixed walls for their protection, with only slight disturbance from excretory functions, while pathologic changes in the proximity of the chest wall are subject to continued irritation due to respiratory movements, as well as pressure from the almost continual variation of body posture.

Often the resulting exudates and adhesions of salpingitis are painless, while adhesions from an old or new pleuritis give rise to stabbing pain from movements, like sneezing, coughing or muscular effort.

Any maneuver separating the adhesions would be of great benefit. Similar results obtain when the lesion is immediately below the diaphragm. There, however, pain is frequently associated with gastrointestinal disturbance and concomitant involvement of the liver, pancreas, large glands, or a movable kidney. These facts indicate a greater demand for surgical attention to manifestations of disease here than in the famous pelvic region.

An incision through the upper right semilunaris is practically bloodless and has, *per se,* no mortality, and yet what a field for investigation! Beneath the space not larger than the palm of one's hand, and with the center midway between the tenth rib and the umbilicus, we find the gall bladder, hepatic and pancreatic ducts, part of the liver and kidney, the pyloric end of the stomach, part of the duodenum, colon, omentum, mesentery and important vessels. When diseased, many other important structures have occupied this space. Clinically, we are supposed to be able to diagnose gallstones. Thirty years' personal observation, W. Mayo's St. Mary's Hospital reports, and postmortem findings the world

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over, show that they are oftener overlooked than found. Pancreatic disease is much more obscure. Abscess of the liver, or hydatids, cancer of pylorus, usually definitely proclaim their presence. There remain, however, many inflammatory and non-malignant conditions which leave vague contradictory or puzzling symptoms, following one or more acute attacks of various affections incident to this location. Selecting only those not benefited by drugs or massage, but aggravated by driving, riding, jolting or by ordinary manual labor, we have abundant reason for exploratory and radical surgery in this region. The arrangement and anatomic support of the upper abdominal viscera are such that the danger of a hernia following section of the abdominal wall here is much less than below the umbilicus. The same causes make greater probability of permanent cure following division of adhesions.

It has been quite common to discourage any operation in the region of the gall bladder until the surgeon was confident of finding stones. The same may be said of operations looking to examination of the kidney. Pancreatic disorders and disease of the blood vessels are free from liability of harm from such investigation through an incision at this point, or through the linea alba. There are many cases in which a reasonably certain diagnosis of disease of the gall bladder is made, when it is not expected that calculi are present; but we may wish to drain through the kidney pouch for empyema, or chronic catarrh, or examine for results from trauma.

When we contemplate the important organs which may be readily and with great safety thoroughly examined through a window in the right hypochondrium, we shall find at least a reasonable excuse for the exploratory incision, which has so often been the open door for relief of undiagnosed pathology of the lower abdomen.

CASE 1.—J. S., Kidder, N. D., farmer, aged 28, family history negative. In spring of 1896 had an attack of vomiting with pain over stomach which lasted two months. Has had severe recurrence each year, one beginning a year ago, and has been

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constant since. Operated on May, 1902. No gallstones, but vermiform appendix inflamed and adherent to gall bladder and liver. Appendix removed, adhesions separated and colon replaced in normal position. Good recovery and present health good.

CASE 2.—G. F. P., Wilmot, S. D., senator, aged 40. For two years has had "spells" of pain in right side in hepatic region. When the attack was severe the pain would extend from shoulder to groin and be attended with jaundice. Present attack began one month ago with icterus and putty-colored stools. Operated on Sept. 7, 1902. No calculi in bladder or ducts. Evidence of local inflammation and adhesions. Latter broken up. Uneventful recovery.

CASE 3.—Mrs. N. S., housewife, aged 23, emaciated, anemic, jaundiced and neurasthenic. Had hepatic colic three years ago, passed stone; several attacks since; last three weeks ago. Patient constipated, has clay-colored stools, pain over gall bladder, usual gallstone symptoms. Operated on at Asbury Hospital March 14, 1901. Incision right of rectus, gall bladder found twisted and bent or doubled on itself. Covered with adhesions of omentum to gall bladder and liver. No stones present, all adhesions divided; gall bladder liberated, wound closed; uneventful recovery, icterus gone. Good health reported November, 1902.

CASE 4.—C. S. P., Estelline, S. D., male, farm owner, aged 45, member house of legislature. Entered Asbury Hospital Oct. 14,1901. Father died at 71 of "heart failure"; mother living and well; two brothers died in infancy; one sister had consumption at 22. Patient has always been well until some time in June, 1900, when he had very severe pain in right hypochondriac region, requiring opiates. Severe pain ceased one month ago, leaving a sore spot to right of ensiform cartilage. Sept. 1, 1901, he had another attack, and again October 1. Operated on Oct. 15, 1901. No gallstones in bladder or ducts. Extensive adhesions; frail-like mesh work extending widely under lower surface of liver, extending to stomach covering in gall bladder and intestines. Have seen this patient twice during past two years, has gained 30 pounds and has had no further trouble.

CASE 5.—Miss B., Drayton, N. D., student, aged 19. Family history good. Present illness began four years ago with pain in right side. No tenderness until last year, when point of pain located between crest of ilium and lower rib. Patient neurotic and has lost much flesh the last six months. Operated on at Asbury Hospital April 5, 1902. Incision in upper right semilunaris, found omentum massed in right side with evidence of inflammation extending from colon to liver. Coils of intestine and omentum adherent to right mural peritoneum. No stones in gall bladder. Appendix removed. Patient had peritonitis for two weeks and convalesced slowly. A week

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later had an attack of dyspnea, feeble pulse, lividity and was evidently near dying. Had dilated heart. Recovered in two weeks, so as to be able to return home. Returned to hospital Nov. 1, 1902, with pain in right ovarian region. Has gained 40 pounds in flesh and has bright, rosy cheeks. Was put under local treatment of douche and external massage for two weeks with no benefit. Operated on November 16, removing left ovarian cyst three inches in diameter, also removed right tube for extensive salpingitis. Is about the hospital, complains of neuralgic pains in various parts of the body.

This group of cases simply shows benefits from so-called liver cases which drugs and diet did not help. Case 3 is evidence that gallstones may be expelled by way of the bile ducts and leave more pathology behind than their presence manifested.

In Case 4, although the appendix was involved, the condition and symptoms warranted the conclusions that the pathologic conditions began at the gall bladder and a general peritonitis followed, finally involving the pelvic organs. Had this case been explored four years earlier, I have no doubt the ovaries could have escaped disease and removal.

DISCUSSION

ON PAPERS OF DRS. DAVIS AND DUNSMOOR.

DR. WILLIAM J. MAYO, Rochester, Minn.—Dr. Dunsmoor has called our attention to the necessity of frequent operation in the region of the gall bladder. Let us not forget that there are two kinds of diagnoses; one that is exact, in which we know what we are going to do, and the other a diagnosis, which must be very commonly made, in which we can not say exactly what the condition is, but in which we do know that a condition exists which can probably be relieved only by surgical interference and, therefore, a diagnosis that would necessitate surgical interference need not necessarily carry with it an accurate diagnosis of the condition that we expect to find.

I am most heartily in sympathy with the general idea of the paper by Dr. Davis that the gall bladder should be removed, if we can do so safely. But we can not always do this. These people are sometimes very fleshy, and possibly have degenerative lesions, which may be at an advanced stage. Therefore, it is wise to study up the causes that have given us the after-trouble in the past following cholecystostomy, so that we can say to ourselves at the operating table, this case should have the gall bladder removed; this case may not need it. Some time ago I went over the causes of death in our series of several

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hundreds of operations on the gall bladder and there was but one from peritonitis. The danger of peritonitis, if proper gauze protection is employed during operation, is not great. The cause of death is more frequently suppression of the liver function. The liver has carried to it certain infectious material, and if its action is not good, that patient may die from suppression of the liver function, in from forty-eight to seventy-two hours, and this class of cases constitutes about one-third of our death rate. Therefore, we must say to ourselves, there is a class of cases in which there is a certain amount of increased danger attendant on the removal of the gall bladder, and experience has taught us that it is not necessary. What class of cases is it, then, that we can say to ourselves that it is wise for us to remove the gall bladder? It is those cases in which there is stone in the cystic duct or obstruction of the gall bladder, for here future trouble with drainage may cause colics or fistula. In cases in which the gall bladder is obstructed at the cystic duct, I think it should be removed. But if the gall bladder contains bile and the cystic duct is freely open, and one ties it, there will possibly be some deaths from suppression of the liver function; and, therefore, I make it a rule, in cases where the cystic duct is freely open, where there is bile in the gall bladder and the gall bladder is more or less infected, to provide for drainage through the cystic duct, either by doing a cholecystostomy or by amputating the fundus of the gall bladder and removing the mucous membrane from the base. In this way, the cystic duct can be divided and left open for drainage of bile to the surface, the outer coats of the base forming a pouch into which a drainage tube can be securely fastened against the open cystic duct and safely carry the bile without leaking. This gives the benefit of temporary hepatic drainage, with the permanent effects of cholecystectomy.

Dr. J. B. Murphy, Chicago—Dr. Davis has stimulated my courage to take out more gall bladders in the future than I have in the past, and I am a coward in doing any class of surgery that I believe increases the risk to the patient. All the time, I have been asking myself the same questions that Dr. Mayo has; why should we not have a return of the symptoms, if we do not remove the gall bladder, and, indeed, I am not sure that we do not sometimes have a return of the symptoms even after the gall bladder has been removed. The principal causes of the return of the symptoms are two: remaining stones and affections of the cystic duct. Therefore, if these are the two principal sources of the return of the symptoms, it means that the symptoms recur as a result of imperfect operative procedure in the first operation, and I personally plead guilty that my early operations were not as good as they are now, and I frequently have recurrences even now. Now, this brings us to the consideration of the two elements of the primary operation, namely: first, the thorough

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examination of the cystic duct to see if there are any stones remaining, and second, a careful examination and removal of any adhesions which may be on the lower side. These two elements, I believe, will contribute to the improvement of our results without increasing the risk to the patient. Personally, if I could with equal safety feel that the gall bladder could be removed without interference with the function of the liver, I would do so. The mortality in these operations is 47 per cent. I do not know of any work in the region of the gall bladder that gives that percentage, and I am against any operation that reaches such a high mortality. Where infection is present, and where the infection has been multiplied for weeks, I do not feel like doing any more surgery than is absolutely necessary for drainage.

In reference to Dr. Dunsmoor's remark that we must do more work of an exploratory character in the region of the gall bladder, where the symptoms of pain are absent, I think if we would follow out his suggestions in this direction we would receive very good results, with very little risk to the patient.

Dr. A. J. Ochsner, Chicago—This condition of untreated gall bladder cases exists in nearly every part of the country. This condition was impressed on my mind most forcibly by Dr. Mayo some years ago, when I observed his many operations for this condition. In reply to my inquiry in regard to the reason why he obtained, relatively, so many of these cases, he replied that he made the diagnosis. He did not say this to be quoted, and he did not think that I would tell it to this or any other society, but it is true that we do not make the diagnosis unless our attention has been called to the fact that there is a very large number of cases suffering from so-called gastritis or indigestion due to a condition of the small intestines, chronic appendicitis or loose kidney, which are, in fact, suffering from gallstones. The difficulty is that we have simply learned to diagnose gastritis whenever there is a pain in the region of the stomach. I believe that when our attention has been called to this fact, as it has by this paper to-day, we are likely to look for more definite symptoms before making a diagnosis of gastritis, and that in these cases we will investigate further and make a diagnosis of gall bladder trouble. In my own case, I went home and removed the gallstones from the cases which I had previously referred to the internist to treat for gastritis, and I have operated on several hundred of these cases since.

With regard to the paper of Dr. Davis, I would say that every surgeon as he increases his experience increases the number of cholecystectomies, because he differentiates between the cases that will get well after simple cholecystostomy and those in which a secondary operation must be performed, and with our increasing experience we make a very careful and thorough examination of the case after the abdomen is opened. The diagnosis that we can make before the abdomen is opened is

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only sufficient to indicate that an abdominal operation should be done. But the accurate diagnosis must be made after the abdomen is opened, and the various steps which Dr. Murphy has described must be followed. The common duct, the cystic duct and the gall bladder should be carefully examined. If the cystic duct is obstructed either from the presence of stone or of cicatricial tissue, and the patient's condition is sufficiently good, then our experience teaches us that the gall bladder should be excised. I believe it is better for the patient and the surgeon to make a cholecystostomy at the time of the primary operation in patients with little strength, because he will recover, and will be comparatively normal until later, when it is safe to make a secondary cholecystectomy. I agree fully with all that Dr. Davis has said in regard to gall bladder surgery.

Dr. William D. Hamilton, Columbus, Ohio—About two years ago, while in England, I went to Leeds and saw work, especially choledochotomies, done by A. W. Mayo Robson, whose great skill in the surgery of the upper abdomen can not be disputed, he having done with an amazingly small mortality about one thousand operations in this region. I should have been very grateful had any of the essayists this afternoon thrown further light on how to do these things.

Any man who undertakes operations in the gall bladder region must be prepared to incise the gall bladder or cystic or comon duct or duodenum, if required, for clearing any portion of the biliary passages.

I got from Dr. Robson the idea that it is only when the gall bladder is pathologically spoiled, so that it can no longer with safety be retained or used for drainage, that he removes it. A pad is put under the patient's back, 18x6x3½ inches, and under the liver line. The effect is to raise the spine, liver and bile ducts, bringing them nearer to the surface. The right rectus muscle is split in its middle from the level of the gall bladder upward, instead of downward, as was formerly done, and I want to emphasize this point. If necessary, he carries the incision clear up to the interval between the ensiform cartilage and right costal margin as far as possible. This exposes freely the upper surface of the liver. The liver can then be drawn downward and forward with the gall bladder in one hand of the assistant, while his left hand retracts the edge of the incision, and contiguous organs, thus displaying the cystic and common ducts from the top of the gall bladder to the duodenum in a straight line, provided adhesions have been already freed. One can thus easily open the common bile duct, clear it and stitch it without needle forceps, a method which I have successfully used.

Dr. B. B. Davis, Omaha—The question that has been dwelt on considerably in the discussion seems to be the danger of doing a cholecystectomy, when we must jeopardize the life of our patient in doing so. I attempted in my paper to throw

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out this suggestion, that if the condition of the patient were such, or the surrounding conditions such as to make the removal of the gall bladder not an ideal operation, or to render it dangerous, then I would at first resort to the correction of the trouble, and later I would do a more radical operation, if necessary. I feel that this is very important. There are many cases which come to operation which are absolutely unable to bear a severe procedure. In regard to the point made by the last gentlemen, I do feel that if all the cases of gallstones were operated on very early it would give rise to a complete cure in every case, and cholecystectomy would probably answer the purpose, but in my experience it seems to me that at least nine-tenths of the cases have been complicated. I have had a great many where there was obstruction of the cystic duct. I have found stone in the cystic duct. I have found a great mass of adhesions. I have found a very greatly contracted gall bladder; frequently with very thick and friable walls, absolutely useless and detrimental to the recovery of the patient. It seems to me in these cases that it is absolutely necessary to have the bladder removed, in order that the patient may get well. Fortunately in these cases the gall bladder is completely shut off from biliary circulation. Of course, in these cases the only method is the removal of the gall bladder. To my mind the cases which will not demand cholecystectomy are the simple early cases, and the cases which really need cholecystectomy in order to make a complete cure are those complicated cases which we hope in the future will not be so common as they have been in the past.

Dr. F. A. Dunsmoor, Minneapolis—No man should attempt to do an exploratory operation on the gall bladder unless he is thoroughly competent to do any operation that he may find the condition demands when he opens the abdomen. If he is not able to do this, he should not explore, but should let somebody else do so who is qualified to meet the many emergencies of gall bladder work. I wish to say in regard to the gall bladder's mistaken function, that it is not always the place where the gallstones are formed. I have found plenty of gallstones that were not in the gall bladder. I don't mean in the cystic duct, nor in the common duct, but in the substance of the liver. I recall two cases in which there were numerous gallstones scattered throughout the substance of the liver, one associated with hepatic abscess, both with icterus.

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CONTRIBUTION TO THE SURGERY OF GASTRIC ULCER.

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The literature on the surgical treatment of ulcer of the stomach has, during the last few years, grown to vast proportions and the subject has been most ably and thoroughly presented. It is not my intention to attempt a résumé of this literature, nor to take up the subject of gastric ulcer in detail.

There is, however, one of the frequent complications or sequelæ of chronic ulcer of the stomach which my experience indicates will bear still further discussion than it has been generally accorded. I refer to adhesions of the stomach to a neighboring viscus or the abdominal wall, and this paper will be confined to a brief consideration of the symtomology, diagnosis and treatment of this condition.

Enough has been said and written concerning the surgical treatment of alarming hemorrhage, perforation and dilatation of the stomach resulting from ulceration of the organ, to establish quite firmly good and sufficient rules for guidance as to our management of these dangerous and distressing complications and we find these rules very generally accepted and applied.

The adhesion of the stomach to a neighboring organ or to the abdominal wall may occasion symptoms quite as distressing as those due to pyloric stenosis and in many instances really jeopardize the life of the patient.

It is the purpose of this article to consider only those cases of adhesion the result of gastric ulcer. That the

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condition may be set up by extension of the inflammatory process from an adjacent viscus as the pancreas or the gall bladder is true and the symptoms and indications for treatment are very similar.

Perigastric adhesions as sequelæ of gastric ulcer are due to the gradual involvement of the serous coat, by the extension of the ulcerative process, with a localized peritonitis as the result which secures the adhesion of the infected area to that organ or organs with which it comes in contact. In 226 cases of chronic ulcer of the stomach, collected by Fenwick, postmortem examination revealed the presence of adhesions in 96, or 42.5 per cent.

In 123 cases of ulcer with adhesions, collected by the same authority, the pancreas was involved in 49, the liver in 23, the liver and pancreas in 10, the colon in 7, the liver and colon in 4, the spleen in 2, the mesentery in 3, and three or more organs, including, in addition to the above, the omentum, diaphragm, abdominal wall and kidney, in 15. I shall not attempt to discuss the cases where perforation has occurred with a resulting localized abscess, as the symptoms of this condition are usually acute, the septic predominating over those of disturbed function.

It is thus readily seen that the formation of adhesions between the stomach and the other abdominal organs is of such frequent occurrence in cases of chronic ulcer as to vest the subject with considerable importance.

The distribution of these adhesions is readily understood from the fact that about 80 per cent. of all gastric ulcers are situated on the posterior surface of the stomach or at the pylorus.

This, of course, brings the larger number more or less intimately in contact with the liver and pancreas and it is to one or more of these organs that we find the adhesion has most frequently occurred. As would be expected, the next most common point for their formation is the transverse colon. Adhesions to the

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abdominal wall, mesentery, spleen and kidney are relatively uncommon.

The area of the stomach wall involved in the inflammatory process and the density of the resulting adhesion or adhesions are subject to wide variation. We may find a small surface only which has become so fixed, with a resulting conical prolongation of the stomach in that direction or the amount adherent may be as large as the hand. Indeed, in those rare cases of plastic perigastritis the entire surface of the organ may be involved in the inflammatory process and by general widespread adhesions which so compress its walls and diminish its size as to practically put it out of commission. The adhesions may be, and usually are, very dense or, in a few instances, easily separable. In cases where they have been present for a long time and the area of the serosa involved is small, they may have lengthened out into long peritoneal bands, much resembling those found after ventro-suspension of the uterus. In such cases the normal mobility of the stomach may have been restored and the annoying symptoms spontaneously disappear.

SYMPTOMS.

The symptoms due to perigastric adhesions are often very distressing and too frequently misinterpreted. In the milder cases, where the area of the stomach wall involved is small and the adhesions are not put much on the stretch, there may be present, but vague and indefinite, digestive symptoms marked by eructations of gas and even fluid, possibly pain, and a general feeling of gastric unrest.

The symptoms, however, vary in importance and intensity with the portion of the stomach wall involved in the adhesions. If they are at or near the pylorus and seriously interfere with stomach drainage, very extreme disturbances may result. These patients will present symptoms analogous to those accompanying pyloric stenosis, i. e., dilatation of the stomach, eructation of gas and fluid and vomiting, which, in milder cases, may

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occur irreguarly, but in the more severe class soon follows the ingestion of food and may be so frequent and excessive as to seriously endanger life through malnutrition.

Pain is usually present in these cases and in those subject to frequent vomiting is often most intense and distressing. These patients present signs of digestive disturbances that are more or less constant and can not be relieved by ordinary methods of treatment, diet, regulation of mode of living, etc., and in those in whom the functional activity of the stomach is seriously impaired by the adhesions we find a progressive loss of weight, even extreme emaciation, and gradually increasing weakness, terminating in death from starvation and exhaustion.

DIAGNOSIS.

The diagnosis of perigastric adhesions, while presenting many difficulties, should be more frequently made, and in some cases is comparatively easy. Probably those cases will be more easily recognized where the adhesion has formed with the anterior abdominal wall. If the portion of the stomach wall involved is at a point remote from the pylorus the functional disturbance will be slight and marked chiefly by pain while the stomach digestion is at its height. Pressure over this region will elicit tenderness more or less sharply localized, which subsequent examinations will show to be constant at this point. In some patients with thin abdominal walls an area of thickening or induration may be made out.

When the pyloric end of the stomach participates in the adhesion the symptoms are usually very pronounced and may closely resemble those of pyloric stenosis. In other words, they are those resulting from dilatation of the stomach. In these patients the distress is most marked at a time corresponding to the last stage of gastric digestion. Pain appears at this time, which may soon disappear or may last for hours, and is found to

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exist in the right hypochondriac region. During the paroxysm the patient can bear no pressure at this point, and I have known instances where the clothing about the upper abdomen, corset, waist bands, etc., was habitually removed or loosened soon after eating to secure relief from pressure. Vomiting in these cases is an almost constant symptom and may become so constant as to actually threaten the sufferer's life, as is illustrated in Case 1. As time elapses and the dilatation of the stomach increases, owing to impaired drainage, the classical symptoms of that condition, which need not be described to you, become more and more pronounced until the condition of the sufferer is really pitiable. Palpation may in these also reveal, at the point of greatest tenderness, an area of induration. This induration may be marked and easily felt, as in Case 1, or it may be very indistinct or not demonstrable at all.

In those cases where the adhesion exists between the lesser curvature and the under surface of the left lobe of the liver the symptoms are described by Fenwick as follows:

The chief result of the adhesion is to prevent the downward displacement and forward rotation of the stomach which normally follow the ingestion of food and to impede the contractions of its longitudinal and circular muscular fibers. This interference with the motorial functions of the organ is probably responsible for the sense of fulness and discomfort after meals, of which complaint is so often made, and for the flatulence and acidity which ensue from the use of those articles of diet that are difficult of solution or are prone to undergo fermentation.

It is also to be observed that in many cases of this description the patient experiences a constant dragging pain in the epigastrium or right side of the chest, whenever he indulges in physical exertion after meals or suffers from anxiety or excitement. The fact that rest in the recumbent posture or the application of an elastic belt to support the stomach affords relief appears to indicate that the pain is due to a mechanical strain on the adhesions caused by the weight of the organ or by violent contractions of its walls.

In Case 3 of the series here reported the patient, who was a carpet layer, noticed that the pain and discomfort

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was much augmented whenever he got down on his hands and knees to drive tacks in a carpet, and he had to give up this kind of work. The operation revealed the lesser curvature of the stomach adherent to the under surface of the left lobe of the liver, and it may readily be seen that the position above described would increase the dragging on the fixed point. I have since employed this posture as a routine measure in the examination of patients suspected of having perigastric adhesions and it has proven of considerable value as a diagnostic aid. If the adhesion is to the anterior abdominal wall, on the patient's assuming the hands and knees position the pain and sense of dragging will be relieved. If the adhesion exists between the stomach and the liver or pancreas these symptoms are much augmented.

An adhesion existing between the pylorus and the liver presents symptoms closely resembling those described when discussing the adhesion of the pyloric end of the stomach to the abdominal wall. Dilatation, with its distressing symptom complex, appears early and the functional disturbance steadily increases. In these cases the pain is a most variable symptom as to location. In Case 2 the patient complained of almost constant pain immediately under the right nipple. The pain may be most prominent immediately under the ribs on the right side of the chest, radiating from this locality to the right infrascapular region. Deep pressure over the right hypochondrium will usually reveal an area of much tenderness.

If, as frequently occurs, the pyloric end of the stomach is adherent to the gall bladder, interfering by traction on that viscus or its ducts with drainage, we may have added to the symptoms above mentioned those common to disturbance of gall-bladder function. Indeed, the signs may point more emphatically towards gall-bladder disease than to gastric disturbance, as in Case 4, when a diagnosis of cholecystitis having been made, the opera-

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tion revealed an adhesion between the pylorus and the gall bladder due to a chronic gastric ulcer, the separation of which without opening the gall bladder was followed by complete subsidence of the troublesome symptoms.

In very thin patients it may be possible by palpation to feel a hardened area over the right lobe of the liver if it projects, as it frequently does in such cases, below the ribs.

Adhesions occurring between the stomach and colon owing to the mobility of the structures involved, may occasion few troublesome symptoms. If the pylorus should be concerned in the adhesion to the extent of interference with stomach drainage the usual signs of that condition would be manifest.

I have seen but one case of adhesion of the stomach to the colon, and in that instance the patient complained more of symptoms referable to the bowel than to the stomach. Operation in this instance, Case 6, revealed an adhesion between the greater curvature and the transverse colon which, when the stomach was empty, exercised sufficient traction on the colon to produce marked kinking.

The diagnosis of adhesions between the stomach and the pancreas presents many difficulties and may usually be only surmised by the existence of the general symptoms of such adhesions and the acceleration of pain and functional disturbance when the patient assumes the hands and knees or knee chest posture, which will increase the dragging as the stomach pulls on the fixed point.

In patients suspected of having perigastric adhesions the following considerations are of value:

1. The persistence of troublesome symptoms despite careful dietetic and hygienic regulations.

2. Previous history pointing to chronic ulcer of the stomach.

3. Evidence pointing to the occurrence of a localized peritonitis during the ulcerative period.

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4. The fact that change of posture may greatly modify the pain. The hands and knees position increasing the distress in adhesions to the liver and pancreas and relieving that due to adhesion to the abdominal wall. The recumbent posture relieving that due to adhesion to the liver and pancreas and increasing it in adhesion to the abdominal wall.

5. Tight bandaging may ease the distressing symptoms, by relieving tension of the adherent surfaces.

6. The presence of a more or less fixed point of tenderness.

7. The detection of an area of increased resistance or induration.

8. The employment of artificial distension of the stomach for purposes of examination. This will in some cases reveal more or less distortion of the organ and may, in cases of adhesion of the liver, render the adherent area more accessible to palpation. For this purpose the method advocated by Mayo, who uses the stomach tube and the bulb of a Davidson syringe, inflating the stomach with air, will be found most satisfactory.

9. The symptoms and physical signs of gastric dilatation which, when due to perigastric adhesions, come on more suddenly and are accompanied by more pain than when occasioned by cicatrization.

The treatment of perigastric adhesions must be surgical if permanent relief is hoped for.

It is true that in many cases where the adherent area is large and the adhesions very dense, as is frequently the case when the liver and pancreas are involved, even surgery is unable to offer relief, but when the adhesion between the stomach and the liver is not too extensive it may be separated and the patient cured. Adhesions to the pancreas, though presenting many difficulties to operative interference, may, in some instances, be successfully separated. In those cases where the pylorus is adherent to the liver, gall bladder or abdominal wall,

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or where the adhesion exists between the stomach and the colon, brilliant results may be secured by surgical treatment.

As the condition of many of these patients is deplorable, an exploratory laparotomy should be made unless the symptoms point unmistakably to the existence of adhesions so extensive that their separation is out of the question. Operation in any of these cases will, of necessity, be often of an exploratory nature, as an exact diagnosis of the condition is usually impossible. If, when the abdomen is opened, the case is found to be inoperable, so far as the separation of the adhesions is concerned, some relief may be afforded by making a gastroenterostomy at the most dependent portion of the stomach. If it is decided that the adherent surfaces may be separated safely, this is done in the usual manner. If, during the separation of the adhesions, the wall of the stomach or the adherent hollow viscus has been weakened it must be infolded with Lembert sutures. If the separation leaves large raw surfaces the danger of adhesions again forming may be lessened by covering these areas with omentum or Cargile membrane. If dilatation of the stomach is present a gastroenterostomy should be made whether the adhesions are divided or not. Frequently the operation may present many difficulties and again it may be extremely simple. It has, in my experience, proven, on the whole, a very satisfactory procedure to patient and surgeon alike, in evidence of which statement I submit brief histories of seven cases.

These are all cases of perigastric adhesions due to chronic ulcer.

I have not included in this report those cases so frequently encountered of adhesion between the stomach and an inflamed gall bladder, where the gall-bladder symptoms predominate, except in one instance where the diagnosis of gallstones was made and an adhesion between the stomach and an otherwise healthy gall bladder was found.

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CASE 1.—E. J., a female, aged 32 years. She complained of very acute abdominal pain coming on soon after eating, which was frequently attended with vomiting. Coughing, sneezing, etc., were attended by the most excruciating pain. She had been constantly under treatment for one year, her ailment being diagnosed as dyspepsia, and was almost discouraged concerning her condition. Owing to the difficulty with which food was retained in the stomach, she was extremely emaciated. An examination of the abdomen revealed, on palpation, a tender indurated spot about one-half inch above and the same distance to the left of the umbilicus. This, together with the symptoms above enumerated, led to the diagnosis of an adhesion between the stomach and the abdominal wall, with, possibly, the formation of an abscess. The abdomen was opened and the adhesion existing between the anterior surface of the stomach and the abdominal wall was readily found.

This was separated without difficulty. No pus was present and the stomach wall at this point was found to be intact, the ulcer having apparently healed.

The ulcerated area, however, was folded in and retained by close suturing. The troublesome symptoms immediately disappeared and, fifteen months after operation, had not recurred. The patient rapidly regained her lost weight, and has since been in perfect health.

CASE 2.—Male, aged 24. Had been treated three years for gradually increasing symptoms of digestive disturbance. These at first consisted of an uncomfortable sense of fulness after eating, which persisted for some time. Soon he was troubled with eructation of gas and fluid and then with frequent vomiting, which would appear an hour after eating. No history pointing unmistakably to ulcer of the stomach, but at one time had been quite sick for two weeks with symptoms of peritonitis. At the present time all symptoms are much aggravated. Soon after taking food he has severe pain in left side which seems more intense under right nipple. Vomiting soon follows and after emptying the stomach the distress gradually subsides. Has lost much weight and is very much concerned as to his condition. Is ravenously hungry, yet fears to eat. Examination reveals a very tender spot just to the right of the median line under free edge of ribs. At this point an obscure sense of increased resistance is made out by deep palpation. Distension of the stomach with air (Mayo's method) brings on at once all the symptoms of pain and gastric distress and reveals the fact that the organ is much dilated, the lower border being two inches below the umbilicus.

The tender spot above referred to is now so sore that he can scarcely bear the slightest pressure on it. The history, together with the physical signs, led to the provisional diag-

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nosis of adhesions existing between the pyloric end of the stomach and the liver and laparotomy was advised.

At the operation the pylorus was found firmly adherent to the right lobe of the liver, about one square inch of tissue being involved in the adhesion. Separation of the tissue was effected without difficulty and an anterior gastroenterostomy made at the most dependent part of the stomach.

The raw surface of the pylorus was covered with omentum. Relief from all troublesome symptoms was immediate and complete, the young man rapidly regaining his former weight and strength.

Case 3.—Male, aged 37. History pointing to existence of gastric ulcer six years before. For the last few months he had pain after eating, eructations of gas and finally vomiting, which now occurs several times daily. Has lost weight and strength and had to abandon his vocation, that of carpet laying, as the hands and knees posture assumed by him at his work greatly increased the pain. Examination revealed a very tender area exactly in the median line and just at the end of the sternum. Says that he vomits a few minutes after taking food, frequently ejecting all that he has eaten. Is very despondent and threatens suicide unless relieved. On taking the hands and knees position he gives every evidence of suffering intense pain, which is immediately relieved, but not abolished, when he lies on his back. Says that at times if he will lie down immediately after eating that the distressing symptoms may be very much lessened in severity and that he may not vomit at all. He refers the pain to the entire upper abdomen, and says that at its height it extends across from side to side just under the free edge of the ribs.

An exploratory laparotomy revealed extensive adhesions between the lesser curvature of the stomach and the under surface of the left lobe of the liver, involving a surface about two inches in diameter. These adhesions were separated with great difficulty and several vessels required ligation.

The large raw surfaces remaining, both on the stomach and the liver, were covered with Cargile membrane. Shock was pronounced and only overcome by most vigorous measures. To my great gratification readhesion of the denuded surfaces did not take place and recovery was rapid and absolute.

Case 4.—Young woman, aged 23. History of recurrent attacks of pain and soreness in upper abdomen for the last four years. Usually came on an hour or two after eating, and lasted from two or three hours to several days. Intervals between the attacks constantly growing shorter. Pain and sense of burning extending from right hypochondrium across to the left side and up to right shoulder blade. Vomiting occurred frequently, but not always present. Pressure of

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clothing could not be endured during the paroxysm. No history of hematemesis. Examination revealed exquisite tenderness over the gall bladder. The recurrent nature of the trouble, the character of the pain and the location of the tender area led to a diagnosis of gallstones.

Operation revealed an adhesion between the gall bladder and the pylorus, which, when separated, was seen to be due to a chronic gastric ulcer.

The gall bladder was apparently perfectly healthy, no stones could be felt in it or the ducts and the operation was concluded with the separation of the adhesion, and in folding the ulcerated area of the pylorus with Lembert sutures, as the stomach wall at this point appeared very thin.

Complete recovery rapidly ensued, thus adding unmistakable proof that the diagnosis of gall-bladder disease was a mistaken one.

CASE 5.—Married woman, aged 21. History of chronic ulcer of the stomach four years previously. Lately has been suffering extreme pain after eating, which was located in the right hypochondrium and extending to the right chest. Vomiting was of frequent occurrence, coming on soon after eating and she was rapidly losing weight. The entire upper abdomen seemed tender to pressure and she had worn no corset or tight skirts for months.

As long as she remained in the recumbent position the pain and vomiting was less severe and some days she would suffer very little. Exercise greatly aggravated all symptoms.

Operation revealed adhesions between the lesser curvature, just above the pylorus and the liver. These adhesions were very firm and extended over an area half as large as the hand. Their division was quite difficult, and several times I thought I had better give up the attempt. It was finally accomplished and the large raw surfaces covered with omentum and Cargile membrane. The patient stood the operation well and made a good operative recovery, but the troublesome symptoms rapidly recurred, evidently because of the reformation of the adhesions. Refusing further operative interference, the case passed from observation.

A blunder was committed in this case by persisting in separating these wide and dense adhesions and by omitting to make a gastroenterostomy. Confronted again by such conditions, I should perform a gastroenterostomy and let the adhesions alone.

CASE 6.—Married woman, aged 44. History pointing to ulcer of the stomach several years before. For the past three or four years has been troubled with vague and indefinite abdominal symptoms. These were apt to appear three or four hours after taking food and, to use her own description, "the right side would feel as if it were going to burst, while the

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left side felt flat." Pain extended at this time from the ribs to the groin on the right side and across the upper limits of the abdomen and was colicky in character. During the paroxysm distension of the abdomen was quite marked.

Vomiting might occur, but was usually absent. After a time varying from one to three hours, the symptoms would gradually subside, only to reappear following the next meal. Strict adherence to a liquid diet would often grant comparative freedom from the attacks for days at a time, but the taking of solids was certain to be followed by distress. Growing tired of the restricted diet, the patient asked if an operation would not give her relief.

An exploratory laparotomy disclosed an adhesion between the greater curvature of the stomach and the transverse colon which, when the stomach was empty, so drew on the latter as to produce a decided "kinking" of the gut which was sufficiently acute to interfere with the ready passage of its contents.

This adhesion was easily separated and the surfaces participating in it were covered with omentum. Recovery was uneventful and has remained complete.

Case 7.—Male, aged 35. No definite history of ulcer. For several months had been suffering with symptoms of digestive disturbance manifested at first by eructations of gas and fluid and some abdominal tenderness. Soon began to vomit at irregular intervals and at the present time vomiting occurs several times daily and is accompanied by severe dragging pain over the upper abdomen. Is steadily losing weight and has had to entirely abandon business. Examination reveals much tenderness in right hypochondrium and an area of increased resistance above and to the right of the umbilicus. Distension of the stomach with air shows it to be much dilated and its movements may be seen through the thin abdominal wall.

All the symptoms are aggravated on his assuming the "hands and knees" position. Operation revealed adhesions between the pylorus and the liver, the pyloric end of the stomach being held firmly against the under surface of the liver while the stomach, enormously dilated, extended far below the umbilicus. The adhesion was separated with no especial difficulty and a gastroenterostomy was made. Much improvement followed the operation and, although restoration of function was not perfect, the patient having occasional attacks of pain, he had been able to resume active business.

A study of these cases would seem to warrant the following conclusions:

1. Perigastric adhesions as sequelæ of chronic ulcer of the stomach are not uncommon.

2. Their existence should be suspected and even posi-

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tively diagnosed more frequently than has been the case.

3. In many such cases the relief afforded by the operation is absolute and may be secured in no other manner.

4. The operation is often an extremely simple one.

5. If the adhesion involves surfaces so extensive that its recurrence must be inevitable, relief may be best secured by a gastroenterostomy allowing the adhesions to remain.

6. The use of omental grafts or Cargile membrane is of value in preventing the readhesion of the separated surfaces.

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THE SURGICAL CONCEPTION OF PYLORIC OBSTRUCTION.

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Until within the past few years pyloric obstruction was regarded as due either to cancer so situated and so advanced as to render its removal impossible or excessively hazardous, or to a non-malignant pathology usually so obscure and so difficult to diagnose as to make any attempt at surgical interference uncertain and unjustifiable. Hence, surgeons were rarely encouraged to seriously consider operative procedures in stenosis of the pyloric orifice, and the victims of this condition were, with a few exceptions, permitted to die or to drift into chronic invalidism without a single rational effort being made to remove or correct the causative pathology.

It has been only within the past decade that the advances made in the surgery of the upper half of the abdomen and of the stomach in particular have inspired us with a new confidence, and given us a much clearer and more practical idea of this causative pathology, suggested a means of diagnosing it earlier, and indicated plainly the only measures we can reasonably rely on to prolong the lives of these patients or restore them to health.

Those who have kept in touch with these advances and thoughtfully compared their own clinical experience with that of the comparatively few workers in this field will, I believe, agree that the palliative, expectant treatment of the past must eventually give way to the

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more promising, prompt, rational measures suggested by the surgical conception of pyloric obstruction.

These experiences, as I interpret them, teach us that in at least 95 per cent. of all cases this obstruction is due either to cancer, ulcer or inflammatory adhesions, viz., to a pathology that at no time and under no conditions can be removed or corrected by any combination of medicinal or dietetic measures, but which in every instance at some stage of its progress affords an opportune time for removal or favorable modification by appropriate operative procedures.

We have learned, too, that the fears and apprehensions of excessive danger that so long retained our surgical endeavors in the upper half of the abdomen were greatly exaggerated and that the surgery of this part of the peritoneal cavity is not attended by unusual risks if we choose an opportune time for operating, while the morbid process is yet circumscribed and before the recuperative and reparative powers of the patient are exhausted. Indeed, it has been shown that the stomach will bear almost any kind of surgery with comparative safety to the patient if the operator is clean, the patient is in good condition, and the small intestines are not unnecessarily exposed or subjected to trauma.

Instructed by recent operating-room observations, we have modified many of our old ideas of pathology that were formed in the dead house. Not a few of these changes have an important surgical bearing. For example, it has been found that cancer of the pylorus, although situated in a part of the lymphatic system, is singularly slow to extend to nearby glands and, consequently, often offers really a better opportunity for complete removal than cancer of the uterus or breast. (I think it must be very rare, however, to find malignant disease so far advanced as to demand a complete gastrectomy, except the glandular involvement be such as to contraindicate any extensive operation.)

We know that gastric ulcer is rarely single and, while

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one may be able to diagnose and, in the course of the operation, to locate the particular ulcer that produces the symptoms and, perhaps, be tempted to excise it, it is safer to conclude that there may be one, two or three smaller ulcers so obscure as to escape detection or prevent excision. For this reason gastroenterostomy should usually be the preferred surgical treatment for gastric ulcers.

The fact that nearly three-fourths of the present mortality and sufferings from pyloric cancer and ulcer are due to the occlusion of the pyloric orifice must be regarded as a strong plea for the surgeon to relieve the obstructive symptoms, even when it is apparent that the perfect removal of the pathology is impossible or impracticable.

It seems highly probable that neither cancer, ulcer nor inflammatory adhesions are, as a rule, separate and distinct entities in this pathology, but are not infrequently associated as successive factors in the morbid process that results in organic stricture of the pylorus. It is certainly fair to presume that cancer in this region, as in the lip, cervix, nipple and elsewhere, finds its preferred, if not its essential, starting point in cicatricial tissue; and here this cicatricial tissue is most likely to be found about bands of adhesions and the healing of ulcers.

It has been customary in the past to regard blood dyscrasia as the chief cause of gastric ulcer; but I am inclined to believe that this view has been accepted more on account of its being the only available one than because of its sound pathologic basis. To me it seems more consistent to assume that the etiologic factors of gastric ulcer are not different from those of ulcer in other parts of the body, except as modified by local conditions, the anatomic relations and the physiologic functions of the stomach, and that in most instances the necrotic process is preceded by a local circulatory disturbance or lowered vitality of the part, and that in

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the stomach such degenerative changes are hastened and intensified by the well-known digestive effects of the gastric juice on devitalized tissue. The local circulatory disturbance, the locus minoris resistentiæ, is provided here whenever omental attachments or peritoneal adhesions drag, bind or compress any part of the stomach in such a manner as to impair or abolish its physiologic mobility or interfere with its normal blood supply.

That such omental attachments and peritoneal adhesions often occur with any nearby or remote intraperitoneal inflammation will not be questioned by any operator familiar with gall-bladder, appendiceal and tubal inflammations, and is able to recall how almost invariably the omentum is involved and peritoneal adhesions formed.

Just what proportion of cancers are preceded by gastric ulcers and just what proportion of ulcers are caused by peritoneal bands of adhesions or omental attachments, no one as yet may presume to decide; but the fact that there is a very intimate relationship between these causative factors, with an inflammatory lesion at the one extreme and malignant disease at the other, should be kept in mind in taking the history, in making the differential diagnoses and in deciding on the treatment of each case.

I am quite sure that in a number of instances I have been able from the history to trace the successive steps of the pathologic process from an old inflammatory lesion (appendiceal, gall bladder or tubal) to a cancer of the pylorus or to a gastric ulcer; and within the past two months I have operated on two cases where such conclusions were suggested by the history and afterwards verified on the operating table. In one case, the obstruction was due to cicatricial contraction following an ulcer. Some years before, the patient had suffered from a well-marked attack of appendicitis lasting nine weeks. After a recurrent attack symptoms of pyloric obstruction appeared which in time became so aggra-

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vated as to lead him to seek surgical aid. The appendiceal mass, the omental attachment, the ulcer, etc., were demonstrated in the course of the operation. The history of the second case was typical of chronic ulcer with partial occlusion for a period of three years. Since November, 1902, the symptoms had rapidly become more serious and indicative of malignancy. The operation demonstrated the existence of a cancer of the pylorus freely movable and with but little glandular involvement. In this connection is it not logical to believe that the hemorrhage that so often occurs a number of days after gall-bladder operations may be due to ulceration from the above causes rather than from some obscure blood dyscrasia?

This explanation of the etiology of gastric ulcer, which I have submitted for your consideration, not only appears to harmonize with the general teachings of pathology, our operating-room findings and clinical experience, but is apparently supported by the results of a series of experiments on animals which I have recently undertaken, the details of which I hope to make the subject of a future paper.

This, in brief, is an outline of the pathology we may be facing whenever in our consulting room or at the bedside we are confronted by a patient suffering from any serious chronic disease of the stomach. And since the life and health of the possessors of this pathology depend as much on our promptness in recognizing it as on our judgment and skill in correcting it, the first and most important step toward the discharge of our duty to these patients is to hold ourselves prepared and on the alert to detect any early warning symptoms, and to spare no pains in our efforts to look beyond the symptoms to the morbid conditions that produce them.

Undoubtedly in the past we all have been inclined to permit the early stages of organic stricture of the pylorus to escape our observation. So long as an early and positive diagnosis served only to give an early and

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positive assurance of impending death or a life of invalidism, neither physicians nor patients were enthusiastic in securing convincing clinical evidence. The gathering of testimony that can only serve to deprive the patient of the last ray of hope seldom engages the best efforts of the medical profession.

But now as surgeons are beginning to demonstrate to physicians that we have good substantial grounds for our faith in the efficiency of surgery if employed early, we may reasonably hope to win that which at the present time we most need—the confidence of the patient and the co-operation of his first counselor, the internist.

GENERAL RULES FOR DIAGNOSIS.

Time will not permit our dwelling on the symptomatology of pyloric obstruction, and I shall only venture to call your attention to a few general rules that I have found helpful to me in systematizing my examinations and in aiding me to reach an early decision.

First.—Suspect all cases of serious chronic disease of the stomach to be suffering from pyloric obstruction and subject each to a rigid investigation unless the symptoms are plainly due to other causes.

Second.—Since the history is always our earliest and often our most significant and sometimes our only clue, it should be reviewed and studied in every case with scrupulous care, due attention being given to the age and habits of the patient, date of commencement of present illness, location and character of pain, loss of weight, vomiting of blood or undigested food, the length of time after eating the vomiting and pain occur, attaching especial weight to any history of previous attacks of abdominal pain or distress that might indicate a local or general peritonitis.

Third.—Note the appearance of the patient, whether cachectic, jaundiced, anemic or well nourished.

Fourth.—Locate the point of greatest tenderness, determine presence or absence of tumor, note contour of abdomen, and, most important of all, mark out the

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boundaries of the stomach when distended, for marked dilatation is almost pathognomonic of obstruction.

Fifth.—Examination of the stomach contents after a test meal, including the test for hydrochloric acid, may furnish very significant but never positive evidence as to the malignancy or non-malignancy.

Sixth.—The presence of a tumor with or without glandular enlargements is strongly suggestive but not absolute proof of malignancy.

Seventh.—Remember that in spite of the most painstaking investigation a certain proportion of cases will remain obscure if we employ only the ordinary means of diagnosis. In such cases, when malignant disease is suspected, or without such suspicion, if the obstructive symptoms be marked, or the patient is greatly distressed, or his general health and strength are being surely undermined, we have no right to postpone an exploratory incision. For, at the hands of an experienced operator, this is a safe procedure and always gives positive information that is obtainable in no other way. (I am convinced that each year many lives are sacrificed because of our hesitancy or delay in employing this important diagnostic measure.) The fact that pyloric obstruction is always a surgical disease does not mean that all cases are to be invariably subjected to operation. The same conditions that demand an exploratory incision usually require the surgical treatment, for with such symptoms, if there be no organic stricture, there is likely to be angulation of the pylorus due to adhesions, or spasmodic stricture due to ulcer, and neither are susceptible to any non-surgical treatment.

OBJECTS OF SURGICAL TREATMENT.

The modern surgical treatment of pyloric obstruction includes two objects:

First.—The establishing of a communication between the stomach and the duodenum or the jejunum.

Second.—The removal of the causative pathology.

The first is imperative in every instance, and under

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favorable conditions is attended by a moderate risk. The second is always desirable, but not always advisable; for the character and extent of the pathology together with the condition of the patient may not justify us in attempting the second object.

Many ingenious operations have been proposed and practiced for the accomplishment of these two objects. I am impressed, however, that it is a mistake to enter the operating room with the mind over-burdened and perhaps confused with the details of many complicated procedures, and I am sure that better results would be obtained if we, especially those of us who operate infrequently, would strive to perfect our skill and dexterity in the use of a few of the simplest measures that promise to accomplish the objects desired.

SOURCES OF ERROR.

Four other sources of error deserve mention:

First.—Attempting to do too much. The welfare of the patient as well as the best interests of surgery sometimes contraindicate an ideal operation. After doing a gastroenterostomy, it may be even advisable under certain conditions to postpone for a time the removal or correction of the pathology.

Second.—Selecting an operation that requires too long a time for its performance. Very few of these patients reach the operating table in condition to bear a two or three hour operation.

Third.—Forgetting that the first part of the duodenum is but two or three inches long, and one-third of this is only partially covered with peritoneum and a portion of the remainder is usually excised with the disease. Hence, to attach the esophagus or greatly dilated stomach to such a short immovable duodenum might in many instances produce undue tension, which here would be a dangerous violation of a well-known surgical principle. Unquestionably when in doubt the safer course would be to do a gastrojejunostomy.

Fourth.—While in the latter operation it is imma-

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terial whether the anterior or posterior wall of the stomach be entered, it is most essential that the lowest point of the stomach be selected, and that we especially guard against the possibility of any kinking of the jejunum by appropriate measures, even to the doing of a supplementary enteroanastomotic if necessary.

A gastroenterostomy with the Murphy button and a pylorectomy or partial excision of the stomach after the method described by Dr. W. J. Mayo, are procedures that appeal to me on account of their simplicity, ease of execution, short time required and general effectiveness, and in my limited experience they have proven satisfactory. Those more dextrous in intestinal suturing and general operative skill might do well to select other methods or perhaps do away with any mechanical device like the Murphy button.

What, at the present time, needs to engage our thoughtful attention more than the multiplying of operative procedures, is a study of these morbid processes in life as they are revealed to us on the operating table, that we may acquire a quicker perception of the symptoms they produce, and become better prepared to judge when and when not to attempt the removal or correction of the pathology. We need, too, perhaps most of all, to secure the intelligent co-operation of the internists, for until they appreciate that pyloric obstruction is a surgical condition and one that can not be always even diagnosed except by an exploratory incision, and that can never be hopefully treated except by operation—until the internists not only accept these views in theory, but adopt them in practice, the *dernier resort* operation will continue to be the rule and the timely operation the exception, and the greatest benefits to be derived from pyloric surgery will not be realized.

REASONS FOR SURGICAL TREATMENT.

Our reasons for believing that the rational treatment of pyloric obstruction should be based exclusively on

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the surgical conception of the conditions, may be briefly summarized as follows:

First.—In 95 per cent. of all cases the pathology is an organic stricture of malignant or benign origin. It is certainly unreasonable to hope that stricture of this or any other part of the alimentary canal can be overcome except by mechanical means; and it is equally inconsistent to assume that pyloric cancer will yield to palliative treatment or to any other measures that are known to be of no value in the treatment of cancer in other parts of the body.

Second.—Pathology in this region can be reached, exposed and treated quite as conveniently as in other parts of the peritoneal cavity.

Third.—With an early diagnosis and the elimination of the "too late operation," pyloric surgery ought not to be attended by unusual risks, and should promise as good results as surgery done for equally grave conditions in other parts of the peritoneal cavity.

Fourth.—If the ordinary diagnostic measures are not sufficient to enable us to always reach a prompt decision, we know that here a small exploratory incision is a simple, safe procedure, which gives the patient but little discomfort and always affords the surgeon positive information as to the exact conditions.

Fifth.—When life and health are threatened by any intraperitoneal disease, benign or malignant, the timely removal or correction of the causative pathology by mechanical means is a rational procedure of proven value which we should always thoughtfully consider before we permit ourselves to regard the condition hopeless, or subject our patients to the chances of any empiric treatment.

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CLINICAL OBSERVATIONS IN STOMACH SURGERY.

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Surgery of the stomach is still in a developmental state. Many surgeons are making progress in this field, and although there can not as yet be many conclusions which can reasonably be expected to be permanent, still it seems worth the effort to exchange the points of clinical experience at this time.

It is, of course, out of the question to discuss this subject thoroughly in the time given to a paper in this Section, but I believe that it will be possible to present the features which seem of greatest practical importance as they have impressed themselves on me in my clinical observations.

Ultimately the greatest portion of stomach surgery must be done for the relief of gastric ulcer or one of its various sequelæ—hemorrhage, perforation, adhesions, cicatricial contraction with pyloric obstruction and its consequent gastric dilatation, hour-glass stomach and carcinoma. The wider my field of observation has become the more I am convinced that there is in this condition a great opportunity for surgical work of the highest value.

The operation for the relief of hemorrhage from a gastric ulcer, introduced by Mikulicz sixteen years ago, which has been practiced by many surgeons, but was

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brought to the general attention of the surgical profession especially by the clearness and force of Mayo Robson's writings, will become less and less indicated as the practitioners of internal medicine become convinced of the fact that these cases can be safely relieved by a simple operation performed in the interval between attacks.

The same condition will reduce the frequency with which the surgeon will be called on to operate for the relief of perforative gastric ulcer. The statistics of Wier and Foote and those of Tinker will serve to indicate the gravity of this operation, especially when compared with the statistics of Mayo, Finney and others, of operations performed in the interval.

In all cases of ulcer of the stomach which do not heal completely and permanently by internal treatment or in which the healing is followed by pyloric obstruction, it seems proper that surgical treatment be employed. There are three factors which aid greatly in bringing about this conclusion: 1. The diagnosis can now usually be made without difficulty because the attention of the profession has been sufficiently directed toward this condition to make its recognition probable. 2. The operative technic has been so thoroughly perfected that interval operations are accompanied by very little danger. 3. A sufficient number of cases have been observed for a number of years to make the permanency of cure an established fact.

Mayo established the principle of providing perfect drainage of the deformed stomach by making an anastomosis between the very lowest portion of this organ with the jejunum. This is the most important factor which has served to build up a satisfactory technic in this class of cases. Many surgeons operating on the stomach have not yet grasped this idea. This is true especially of the surgeons who have been unsuccessful in this class of work. It should be stated here that in making a posterior gastroenterostomy the surgeon will employ this

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principle in most cases, whether he does it intentionally or accidentally, but in the anterior operation he is just as certain not to do this, unless his attention is fixed on this end at the time of the operation.

In my own experience the persistent vomiting after gastroenterostomy—"vicious circle"—has been absent since I appreciated this principle and have applied it. The vomiting simply resulted from the fact that fluid could not help flowing into the stomach from the proximal end of the small intestine, because it had to flow down hill, the opening in the stomach not being in the lowest point of this organ. All that has been said and written concerning the cause of this pernicious vomiting, with the exception of what refers to this one condition, is, I believe, based on faulty observation, and all of the complicated operations which have been invented to prevent this vomiting are unnecessary, if the principle introduced by Mayo is properly appreciated and applied.

ELASTIC LIGATURE METHOD.

It is probably of little importance whether the anastomosis is made with ordinary sutures or with those aided by a mechanical splint, like the Mayo-Robson decalcified bone bobbin, or with the Murphy button. In all but thirteen of my cases I have used the Murphy button, in four the needle and thread and in nine the McGraw elastic ligature. All of the latter I have made during the present year, and have found the method exceedingly easy and satisfactory so far as the immediate results are concerned. None of the patients showed any shock. They were all able to sit up in bed on the day following the operation and all recovered. The time which has elapsed since these operations were performed is, however, too short to determine the ultimate result. The points of importance in this method are that as large an opening as desired can be obtained and that there can not possibly be either separation or leakage or infection from the intestinal or stomach contents.

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In applying the method the following conditions must be borne in mind: 1. A round rubber cord 2 mm. in diameter, made of the best material, should be used. 2. A posterior row of Lembert sutures is applied. 3. A long, straight needle armed with the rubber ligature is passed into the lumen of the intestine and out again at the desired distance, from 5 to 10 c.m. away from the point of introduction. 4. While an assistant holds the intestine the surgeon stretches the rubber in the needle and when quite thin draws it rapidly through the intestine. 5. The same step is repeated through the stomach. 6. A strong silk ligature is placed across and underneath the rubber ligature between the latter and the point where the stomach and intestine come together. 7. A single tie is made in the rubber ligature after the latter has been drawn very tightly. 8. The silk ligature is passed around the ends of the rubber ligature where they cross and tied securely three times. 9. The ends of the latter are released and cut off, being held by the silk ligature. 10. The Lembert suture is continued around in front until the point of its beginning is reached, where it will be tied. 11. Care must be exercised to prevent tying the rubber ligature too far backward and thus getting behind the posterior row of Lembert sutures.

I am thus explicit in describing the steps of this operation because I find that only those who are thoroughly familiar with the method have used it, and apparently all with great satisfaction.

It has been found that a gastroenterostomy opening made with a Murphy button will remain open and act perfectly in cases in which the pylorus is permanently occluded, but in cases in which it is only temporarily occluded because of an open ulcer with its resulting induration and edema, the gastroenterostomy opening contracts as soon as the pylorus again becomes normal or nearly so. Unfortunately, this closure of the gastroenterostomy opening is likely to be followed by a recurrence of the ulcer and the consequent obstruction of

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this orifice, which frequently necessitates a repetition of the operation.

This can be avoided by making an excision of the pylorus at the time of the primary operation or by closing the pylorus with a silver wire passed around the pyloric end of the stomach or the beginning of the duodenum two or three times, drawing it just tightly enough to occlude this orifice completely, but not sufficiently tight to cause pressure necrosis. This method has, however, not been tried sufficiently to secure its absolute establishment.

It is claimed that by making a large anastomotic opening by means of the McGraw elastic ligature one can secure a permanent opening under all conditions. My own cases are still too recent to be of value in confirming this claim. The results secured in cases of the class under consideration by the operation of gastroenterostomy properly performed are certainly very encouraging.

Recently Fowler has described an operation consisting in gastroenterostomy and enteroenterostomy between the portions of the jejunum at the proximal and distal side of the point at which the anastomosis was made with the stomach. Aside from this the intestine is occluded by means of a silver wire passed three times around its lumen between the point at which it is anastomosed with jejunum and the stomach, so that the bile and pancreatic fluid can be emptied into the small intestine, but not into the stomach. This operation has given very satisfactory results in the hands of its author, but in my experience the much simpler method of making an anastomosis between the lowest portion of the stomach and the jejunum has been so satisfactory that I have not found it necessary to make the more complicated operation.

PYLOROPLASTY.

Operations for the enlargement of a contracted pylorus have not been very satisfactory, principally because the obstruction was not fully relieved by the op-

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eration usually employed—the Heinecke-Mikulicz or some modification of this—on account of the pouch-like deformity which is present in most of these cases, necessitating the elevation of the food to the level of the pylorus before it can be emptied into the duodenum even after the plastic operation has been made on the contracted pylorus.

One year ago Finney published a method which seems to promise well, but it has not attained sufficient age to have stood the practical test of time. I have employed this method but once, making use of the McGraw elastic ligature instead of making the horse-shoe shaped incision.

Theoretically this is a good operation and practically it can be performed with great ease. It will be interesting to observe the permanent results in the cases which have been operated on by this method during the past year.

In many cases a very moderate pyloric obstruction will give rise to most distressing symptoms because it is accompanied not only with a pouch-like deformity of the greater curvature of the stomach, but because at the same time gastroptosis is present. Thus the normal drainage of the stomach is interfered with mechanically in three ways: 1. By the constriction of the pylorus. 2. By the deformity. 3. By the malposition of the organ.

In simple enteroptosis a number of authors claim great benefit to the patient from various operations intended to elevate the organ. Most of these methods interfere seriously with the mobility of the organ and are painful, for a time at least.

This is not the case with the method described and practiced by Beyea, and that devised independently by Bier. These methods are very similar and virtually consist in shortening the gastrohepatic and gastrophrenic ligaments by means of several rows of fine silk sutures.

Experience seems to show that this method gives permanent relief in simple gastroptosis, the pain dis-

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appearing quickly and permanently, and the patient gaining rapidly in weight and strength. Whether this method is applicable to cases such as I have described remains to be seen by experience.

I have operated on but two of these cases by a method similar to those mentioned above, but which at the same time fixed the stomach to the abdominal wall. The results were so unsatisfactory, although in each case I could note some improvement, that I did not repeat the operation.

Since studying the methods described by Beyea and Bier, it seems plain that the interference with the mobility of the stomach prevented the complete recovery of my patients, and that with better technic the results would have been better.

OBSTRUCTION OF PYLORUS DUE TO CARCINOMA.

In carcinoma of the pylorus there is never any indication for performing a complicated operation similar to that described by Fowler in connection with gastroenterostomy, because the pylorus is permanently obstructed at the time of the operation, and this obstruction becomes more complete as time progresses.

In cases in which the tumor is sufficiently circumscribed to make its removal practicable, there is again no occasion for performing any operation except an anastomosis between the remnant of the stomach and the jejunum. It is, however, important to select a point sufficiently distant from the point at which the duodenum passes through the mesocolon to avoid all tension. The operation is very simple if performed after a definite plan.

The duodenum is clamped double after tearing a small opening through the folds of the omenta above and below. It is then severed between these clamps. A circular silk suture is applied to the end of the duodenum, and while this is tied the crushed end is inverted into the lumen of the intestine. A few sutures will serve to cover this circular purse-string suture and complete the closure

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of the intestine. Then the greater and lesser omentum are caught successively, always between two pairs of forceps, care being taken not to injure the pancreas behind the duodenum to the right and the vessels supplying the colon below.

In this manner any desired portion of the stomach or the entire organ can be removed without causing any considerable amount of shock or the loss of much blood. When a safe point has been reached beyond the growth, two pairs of clamp forceps are again applied and the same steps repeated that were described in connection with the duodenum. Instead of applying a purse-string suture, however, it is best to apply a simple glover's stitch, grasping the stomach wall to either side of the clamp forceps, and passing loosely across the latter. When the entire row of sutures has been applied, the forceps are loosened and the suture drawn tightly. This serves to insert the crushed end of the stomach into its lumen. Then a second row of continuous Lembert sutures is applied over this row, leaving the stomach in the form of a closed sac. An anastomosis is now made between the remaining portion of the stomach and the duodenum, preferably by means of the Murphy button. At this point it is of the greatest importance, first, to choose the lowest point of the stomach; second, to select a portion of the jejunum which is sufficiently free to prevent all tension.

Of course, in cases in which it is not possible to remove the entire tumor, it is much better for the patient if only a gastroenterostomy is made to give temporary relief from the pyloric obstruction.

It should be stated here that occasionally a carcinoma will be found which is apparently perfectly movable, but which is found later to have invaded the pancreas, the latter organ being attached to and moving with the stomach.

GASTRECTOMY.

Complete gastrectomy, although it is now a recog-

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nized operation, must always remain rare, because cases in which the disease is sufficiently advanced to require this operation are usually so far advanced that the operation is useless. When indicated, the steps which have just been described are simply to be carried further until the entire organ has been removed. Here again, it is of the utmost importance to unite the esophagus to a loop of the jejunum, sufficiently loose to prevent tension.

I have never removed the entire stomach, but in two cases of partial gastrectomy so small a portion of the cardiac end of the stomach could be preserved that I virtually had an opportunity to test this method. It is very simple, and I believe it must be ordinarily, at least temporarily, successful in cases in which it would be indicated.

In all of these operations there are a few points of great practical value, concerning the preparation of the patient and the after-treatment, which are not generally appreciated and which are consequently worthy of mention in this paper.

Many of these patients entered the hospital in an extremely emaciated condition, because almost always milk is the only food which has been given for a considerable period of time. The stomach contains a quantity of residual decomposing material and the milk which is taken is at once changed into a similar decaying substance, from which it is, of course, impossible to secure any nutrition, even from the portion which may pass the pyloric obstruction into the intestine. If the stomach is carefully irrigated with warm normal salt solution through a large-sized stomach tube before food is given, every three to six hours, the conditions for obtaining some benefit from the food will be greatly improved. In most cases the use of an ounce of one of the various concentrated liquid predigested foods in the market, given in three ounces of normal salt solution after making gastric lavage every three to six hours, will be followed by rapid

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improvement in strength. In this manner the absorption from the stomach of products of decomposition will be prevented, and for this the absorption of at least a small amount of concentrated food will be substituted. It is best at first to spray the pharynx with a 4 per cent. solution of cocain and to permit the patient to swallow a little of this rather than to wait for five minutes before introducing the stomach tube. This will prevent unnecessary gagging and discomfort of the patient.

It is well to introduce through the stomach tube into the stomach once a day, or less frequently, after the lavage, two ounces of castor oil or olive oil and then to withdraw the tube. Unless the pylorus has been entirely occluded the oil will find its way into the intestine and will aid the nutrition of the patient.

It is well to place these patients on nutrient enemata at the same time. One ounce of one of the liquid predigested foods in the market, dissolved in three ounces of normal salt solution and introduced through a soft rubber catheter which has been inserted a distance of two to three inches, seems to be of the greatest value.

In case the patient is nauseated after the operation, gastric lavage should again be employed at once. If the patient has been accustomed to the use of the stomach tube before the operation, it is, of course, a great advantage to him after the operation.

It is important to use only a small amount of water in making gastric lavage after the operation for fear of disturbing the healing of the wound in the stomach. We introduce but half a pint at a time. Neglecting this precaution caused the death of one of my patients.

Rectal feeding should be continued for two weeks after the operation, but small amounts of predigested liquid nourishment may be given every three hours by mouth after the fourth or fifth day in most cases.

I have reviewed the histories of the cases on which I have made stomach operations at the Augustana Hospital, and find that in seven cases gastrostomies were

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made for the relief of obstruction of the esophagus; one of these was made for the purpose of dilating a benign stricture, one for the purpose of feeding a patient who had been starved to a mere skeleton because of the presence of a diverticulum which had completely occluded the esophagus. The former case recovered, the latter died of exhaustion. She was in an almost hopeless condition when she entered the hospital. Of the five remaining cases operated on for obstruction of the esophagus due to carcinoma, three recovered and two died of exhaustion, being in a hopelessly starved condition when admitted.

Two cases operated on for perforation of the stomach, one due to ulcer, the other due to gunshot wound, both died from diffuse peritonitis which was present at the time of admission. In each case the perforation had existed for eighteen hours and the abdominal cavity was full of food and a thin cloudy fluid.

There were nine pylorectomies and incomplete gastrectomies with three deaths, one from shock two hours after the operation, one from overdistension of the small remnant of the stomach with fluid during gastric lavage after the patient had been normal for four days. The lavage was ordered because the patient was slightly nauseated and the nurse misunderstood the order in regard to the quantity to be used at a time. The third case died as a result of loosening of a Murphy button on the seventh day. The patient was badly nourished, and it is likely that union was retarded.

In the first of these three cases a gastroenterostomy should have been made, because the patient's condition was greatly reduced on account of the complete obstruction of the pylorus by the carcinoma, but the tumor seemed so completely confined to the stomach that it seemed as though its removal might result in a permanent cure. In the second case, the death was plainly due to an accident, which could have been avoided. In the third case I believe that my technic was at fault.

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There were seventeen gastroenterostomies for the relief of non-malignant obstruction of the pylorus. Of these sixteen recovered and one died. The latter was a patient 74 years of age, greatly reduced in strength, with an almost complete cicatricial obstruction of the pylorus. Her death was due to exhaustion.

There were also twenty-one gastroenterostomies for the relief of pyloric obstruction due to carcinoma in cases in which a complete excision of the tumor was not possible. Of these twenty recovered and one died from exhaustion. The patient was greatly reduced on account of an almost complete obstruction of the pylorus. He was 65 years of age. The autopsy showed perfect healing of the anastomosis and there was no peritonitis.

During the same time I have operated on a number of cases at two other hospitals, but I have not had the necessary time to review the histories of these cases, and consequently this paper was based on the observations made in the study of this series of fifty-six cases.

Regarding the immediate results, I would say that the cases of obstruction due to carcinoma experienced great relief, many of them being not only freed from pain and nausea and vomiting, but gaining very greatly in strength, and almost all expressed their great appreciation of the benefits of the operation. The ultimate results in these cases will be reported later.

In the non-malignant cases I think that there has been great benefit in almost every case. The ultimate results will also be reported later.

It is likely that a larger experience will modify many of the opinions expressed in this paper, and it is not intended that it should carry great weight.

710 Sedgwick Street.

DISCUSSION

ON PAPERS OF DRS. KNOTT, NILES AND OCHSNER.

DR. E. WYLLIS ANDREWS, Chicago—It must be admitted that American surgeons have been backward and that they

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are following in the steps of the Germans in developing gastric surgery. But, of course, we all know that the world recognizes the excellent pioneer work of the American surgeons in intestinal surgery. The evolution of gastric surgery will take over a large number of men, who formerly treated the cases medically, into the surgical domain. We used to accept those cases when they were sent to us by the interne for operation, which was very rarely. Now we assume that the pathology, symptomatology, etiology and indications for operation belong to our field. There is no more reason why a gastric ulcer should be classed as medical than there is why the same condition on the leg or on the tongue should be considered a medical disease. Dr. Dunsmoor expressed his surprise and disapproval that so many surgeons were willing to enter on operative work in the lower abdomen, and were so much afraid of the work above the umbilicus. I remember reading the statement by Dr. Willoughby Furness that the proximity of the solar plexus made surgery in the upper abdomen more dangerous from the standpoint of shock. Now this false conservatism or timidity deters operators in this field, but when you consider the anatomy you will find that it is easier to repair the stomach walls than it is to do the same in one of the small intestines. It is a fertile field for the operator. What are the indications for operative interference in stomach disease? The indications are not simply existence of chronic stomach disease, whose nature we can not determine. I think the trend of modern surgery is in this direction: when we have a case of chronic stomach trouble we operate for diagnosis. How many times a dyspeptic patient will be operated on, say for hemorrhoids, then sent to some specialist, who will remove an ovary; then you may send for some one who will anchor a floating kidney; then for some one, who in despair will remove the appendix; and after all this the patient comes back to you as bad as ever. But if the patient had been sent to a surgeon who would have performed a gastroenterostomy in the first instance, you would have cured the case. Dr. Ochsner spoke of a number of cases in which he had operated for pure gastric pain. Probably he now performs a gastroenterostomy on all cases of obscure gastric pain and cures a large proportion of them. Now, I think we must all recognize that the chain of disorders, beginning with ulcer and ending in stenosis or carcinoma, we have the same indication for early operation that we have in other abdominal conditions. There is frequently the case of the gastric ulcer, running over a period of pain, vomiting and hemorrhage, and later producing carcinomatous degeneration of the healthy tissue. Dr. Bevan has reported a case of pylorectomy for the removal of pyloric carcinoma, which commenced in ulcer of the stomach. Dr. Niles traced

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in his paper the history of a carcinoma of the pyloric end of the stomach, beginning, as you will find nearly every one of them, in gastric ulcer. Surgery must recognize the clinical continuity of these factors ending in carcinoma, and must operate more often in the ulcer stage without waiting for perforation, hematemesis or malignant obstruction.

Dr. William J. Mayo, Rochester, Minn.—The surgery of gastric ulcer at this time is really the surgery of its complications. This is shown by the first two papers that were read to-day in regard to stomach adhesions, pyloric obstruction, hemorrhage and perforation. It is not the gastric ulcer which we have been operating for; it is the complications of the gastric ulcer. We must keep this very clearly in mind. What are we going to do with the cases we see before the complications arise? This is a part of the subject which must be cleared up. The ulcers which produce the complications are usually in the pyloric end of the gastric cavity. The pyloric part of the stomach is the muscular part, and it is on this side that we not only get the gastric ulcer, but at least 60 per cent. of all the gastric cancers, and it is altogether probable that many have their origin in ulcer. We can not usually excise these ulcers, as they are often multiple. I have searched for a bleeding ulcer half an hour and been unable to find it, although the patient had a severe hemorrhage three or four days before the operation. The pyloric obstruction is a complication of gastric ulcer, but the ulcer is there long before you get the obstruction; so that operations on the pylorus can not cure the condition, because the ulcer does not depend on obstruction, and in many of the cases the ulcer is beyond the pylorus in the duodenum, and after plastic operations, which are intended to cure the ulcer by enlarging the pylorus, the food must still pass through the ulcerated area before it reaches the bowel.

Gastroenterostomy is the most satisfactory operation for ulcer, as it drains the stomach at a point to the left of the ulcerated portion, and if the pylorus be obstructed the cure will be permanent; but if the pylorus be open, as soon as the ulcer heals the spasm relaxes and the food passes down through the pylorus again and the fistula contracts, and relapse may occur. In such cases resection of the pyloric end of the stomach or the ulcer bearing area will be best, as recommended by Rodman.

Just a word in regard to cancer. Our only reasonably satisfactory operations for this condition have been extirpation. The operation for pyloric growth usually is not difficult, and by removing all of the lesser curvature the pylorus and the body of the stomach to the left gastroepiploic vessel, all of the lymphatics will be removed and the remaining portion of the stomach may be expected to remain free, as it is isolated

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from the pyloric end by reason of a separate vascular and lymphatic arrangement. In 27 resections of the stomach for cancer, 5 died from the operation, one died later from another cause; but of the 21 that recovered, the average length of life was over a year, one living over three years and two alive and well over two years.

DR. CARL WAGNER, Chicago—Three cases of so-called inoperable carcinomatas, which have occurred in my practice, come to my mind. The most important one afflicted a woman aged 53. She was emaciated to a skeleton and had a tumor of the size of a fist in the stomach region, which first appeared about a half year previous, growing steadily since. The patient presented all the symptoms of carcinoma of the stomach, such as the presence of lactic acid, absence of muriatic acid, emaciation, vomiting and pains. Several surgeons were consulted, who all concurred in the diagnosis of inoperable carcinoma of the pyloric end of the stomach. The patient had another tumor in the inguinal region, below the Poupart ligament, also the size of a fist, which was diagnosed as a lipoma, and, of course, not brought into any connection with the tumor visible in the stomach region. When she came under my care I also was of the opinion that I was confronted with inoperable neoplasm of the stomach, and took therapeutic measures accordingly, until one day I recollected a case of my former experience, where I found, with an exploratory laparotomy, a fatty tumor, originating in the ligamentum teres, hepatis suspensorium and overlying parts of liver, stomach, gall bladder and part of ascending and transverse colon, which caused a condition similar to that presented in the present case. Thus I resorted to an exploratory laparotomy also in this case.

The tumor, which the operation exposed, consisted mainly of omentum, which had converted part of the stomach, colon transversum, liver, gall bladder and the corresponding parietal peritoneum, through exudates and adhesions, into one solid, unique mass. It could be removed very readily, in spite of a few difficulties, and careful examination showed otherwise absolute normal conditions of the organs involved. There were no signs of old ulcer cicatrices in the stomach in spite of the fact that such could have been suspected to exist on account of pains, which the patient stated she had suffered during nineteen years previous to the first appearance of the tumor. This latter misled the physicians to conceive the theory of ulcer, cicatrix and subsequent carcinoma, just as in the book.

I closed the abdomen, somewhat disappointed at not having found any explanation for the development of the inflammatory condition of such grave bearing on the whole organism. However, when I proceeded to extirpate the alleged

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lipoma, which, as above stated, was located at the region of the fossa ovalis femoralis, everything became clear to me. After freeing it from its covering, it unfolded itself just like a lipoma arborescence, such as we find in the knee joint, and with a pedicle as thin as a lead pencil entering into the femoral canal in the peritoneal cavity. On traction it proved to be in connection with the omentum and represented an elongated end-piece of it, which had slipped through the femoral ring in the form of a femoral hernia out of the abdominal cavity, and developed outside of the femoral ring into this large tumor.

The weight of this extra abdominal tumor caused, with every motion, especially when walking, a pulling, jerking sensation at the insertion point of the large omentum, namely, at the large curvature of the stomach, and thus produced intense pains. In the good old German style, hot plates, hot poultices and all kinds of other counter-irritants were applied frequently to the stomach region, during years, with the result that in time local peritonitis, with adhesions and exudate masses, developed. Seven years have elapsed since the operation and the woman is still enjoying very good health. Consequently, the alleged inoperable carcinoma of the stomach, which had reduced the patient to skin and bones, and, undoubtedly, would have terminated her miserable existence within a few weeks on account of marasmus, was no carcinoma at all.

This case serves as an excuse for a plea for greater frequency of exploratory laparotomy in such so-called absolutely hopeless cases of inoperable carcinoma of the stomach.

DR. WILLIAM L. RODMAN, Philadelphia—There is no more important subject at the present time than gastric surgery. Here in America we have been a little slow in moving along in this direction. I think that Dr. Mayo admirably summed up the situation when he said that the surgery of the stomach is principally the surgery of the complications of ulcer rather than the first ulcer itself. I think we should always keep in mind that it is the complications resulting from gastric ulcer that require operations on the stomach. Therefore, as he says, the real question is as to what to do with the gastric ulcers, if they can be diagnosticated sufficiently early to render excision possible. There is no doubt that we will come very early to the excision of the ulcers before complications take place. It has already been done in an increasing number of cases year by year, and I feel that in time the treatment of gastric ulcer will be partial gastrectomy, and that the mortality will not be more than 5 or 10 per cent. Taking all the early operations done during the past fifteen years, it has not been more than 15 per cent., and surely at the present time it should not be more than one-half of that.

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I would like to call attention to one point that Dr. Knott did not refer to in his paper. These adhesions between the anterior wall of the stomach and the abdominal parieties, which would seem to be easy and safe to break up during the operation for gastric ulcer, do not always prove so. Thus, Hoffmeister has said that adhesions should always be picked apart very carefully, having in mind not only the possibility, but the probability of tearing into the wall of the stomach itself.

On one point I would rather differ from Dr. Niles. He speaks of the inadvisability of excision in a majority of instances because of the fact that multiple ulcers may exist. That is true undoubtedly in many instances, but it does not occur sufficiently often to deter one from doing a partial gastrectomy if there is a well-marked tumor, and it may occur even in benign as well as malignant disease. Even if the small ulcer is overlooked, no harm is done. We must remember always, as Dr. Niles and Dr. Murphy and Dr. Ochsner have said, that there always is a marked tendency to the development of benign disease in the stomach, when there has been chronic disease. Some go so far as to make the statement that at least 50 per cent. of all gastric ulcers go on and develop into carcinoma, and we must all admit that a great number do, and it is for this reason that partial gastrectomy, which is not much more dangerous than gastrojejunostomy, is of much more value. I also wish to say with Dr. Ochsner, that we owe a great deal to Dr. Mayo in perfecting anterior gastrojejunostomy. There is no doubt that the anterior operation will closely rival the posterior method, and there is no more reason why the vicious circle should occur when the anterior operation is done, than when the posterior is performed. Personally, I have always employed the latter operation. It seems to me to be the most anatomic, and the majority of writers prefer it to the anterior. The anterior operation is of so much advantage early in the breaking up of these adhesions, that if it can be done without the vicious circle (and I believe it can), it will certainly be used far more in the future than it has in the past. I have no doubt that it is very important that the lowest point on the wall of the stomach be selected, where drainage can be easily established, and in that manner I am sure that the vicious circle will be avoided. I believe that with the operation as performed by Dr. Mayo, or by Dr. Van Hocker, there will be in a certain number of cases the vicious circle, but these cases must be subsequently met by entire anastomosis.

Dr. A. H. Cordier, Kansas City, Mo.—If we could locate the position of the ulcer, on first thought it would seem advisable to excise it, but when we take into consideration the

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pathologic changes, the difficulty of locating the ulcer at the time of the operation, the inability to define its limit, the numerous vascular adhesions to surrounding organs and the slowness with which scar tissue heals, this idea is then dispelled and some other procedure suggests itself that would be equally efficient and less dangerous. This operation I believe to be preferably gastroenterostomy. I have performed a number of these operations. The majority of them have been performed in the anterior wall of the stomach. In none of my cases have I had any trouble from the so-called vicious circle. It is very essential that the opening in the stomach should be at the most dependent point. This feature of the operation I called attention to some eight years ago. Many of these cases at the time of the operation have been erroneously diagnosed as malignant, and even during the operation the indurated mass surrounding the side of the ulcer has been misleading.

When you take into consideration the fact that there frequently exists attachments to the pancreas, the liver and other structures, and that there is an indurated mass with inflammatory and secreticial changes, you can easily understand that one might be lead into believing the condition to be malignant. Hence, many of these cases have been permitted to go on and die as malignant. Cases have recovered from an anastomosis between the stomach and the intestines. That has been so in two or three of my cases. Even at the time of the operation I have made the diagnosis of malignancy. I do not approve of the partial removal of the stomach in malignant cases, as very few, if any, of these cases are permanently cured by such procedure, beside, the operation is one attended with a high mortality, and the patient's condition is not more comfortable during the time that they live than if an anastomosis had been made between the stomach and the intestines. These patients are in a condition, as a rule, that will not tolerate prolonged operative procedures, hence the operation must be quickly performed in order to keep down the mortality.

I would give my preference to the use of the Murphy button in these cases, owing to the time in which it can be done and the fact that the great majority of them recover by this procedure.

Dr. Arthur Dean Bevan, Chicago—I feel that it is unfortunate that this subject has been divided up between two sections. I call attention to the fact that in the Section on Obstetrics and Diseases of Women a paper has been read on the subject of "Gastric Ulcer and Its Complications." I should like, and I think it proper, Mr. Chairman, to call attention to the fact that another Section in the Association is infringing on the rights of this Section, and that a paper is

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being read over there that properly belongs to the Section on Surgery and Anatomy. In the second place, I call attention to the fact that the very important work of obstetrics has been largely omitted by that Section, and on this account I give notice that I shall, at the proper time, make a motion that the delegates of the Section on Surgery and Anatomy be instructed to call the attention of the House of Delegates to this point, and to ask them to notify the Section on Obstetrics and Diseases of Women of this fact, call their attention to the fact that they are infringing on the work of the Section on Surgery and Anatomy, and to instruct them in the future to limit their work to the very important work of obstetrics and the surgical work on the genital organs of women.

DR. VAN BUREN KNOTT, Sioux City, Iowa—The general trend of your remarks seemed to be in accord with the policy urged in my paper; in other words, that the surgery of the stomach is on the increase, and that many cases had been in the past improperly treated or not treated at all, which, in the light of recent knowledge, could have been relieved by surgical methods. While we in the United States have been in the past accused of being behind the advanced position secured by Germany in gastric surgery, we will no longer be liable to such criticism, as in this country as good work is being done in this direction as is done anywhere. With the increased experience gained by the larger volume of work done, our ability to better treat these cases will increase and will be made manifest by better results. The securing of better results will encourage more men to take up this work, and more exact diagnoses will follow, and with the diagnosis will be found the treatment.

DR. H. D. NILES, Salt Lake City—My reason for preferring gastrojejunostomy in the treatment of ulcers of the stomach is that the ulcer will get well, no matter what stage it may have reached, if the part is put at rest. In other words, if you rest the ulcer it will be naturally inclined to heal of itself. Moreover, when you remove the ulcers that you see by excision you are sure to leave two or three there that you can not see, and which in time are pretty sure to do damage. Gastroenterostomy removes all those ulcers which you see, but there still remains those which you do not see. We know that there is a pathology in the upper half of the abdomen, in and about the stomach, that produces many deaths, and we have been discussing these different measures for treatment, while many of our patients go on to death. We know that there is one radical way to reason, and if each of us will be positive in his conviction that there is only one kind of treatment that is based on surgical conception, I am sure that the mortality following gastric pathology or the treatment of gastric pathology will be much less. It is time for this

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gastric pathology to be removed, not only from the domain of medicine, but from obstetrics and gynecology, and the treatment of the future will certainly follow the paths of surgery for the removal of the pathology in the upper half of the abdomen.

DR. A. J. OCHSNER, Chicago—The statistics concerning my own experience which I gave in my paper and the discussion of Dr. Cordier would seem to leave the impression that pylorectomy is an operation which will be likely to be abandoned more and more. The facts of the case are, however, precisely the opposite for the following reasons: Up to the present time these cases have come under our care at a time when the complete removal of the carcinoma of the pylorus was exceedingly improbable, which is shown by the fact that out of 79 cases on which we attempted to operate, 23 were cases in which no operation at all was possible. However, we find that the stomach, with its thick walls and with its distribution of lymphatics, which Dr. Mayo has described, is an organ of which the complete removal is not at all impossible and the statistics of Mikulicz, Czerny, Kocher, Mayo and others would confirm this.

The reason why the mortality has been large in my own cases is that in two cases a fatal blunder was made; in the third case a gastroenterostomy should have been made, in order to make it possible to build up the patient who was virtually starved and a pylorectomy should have been made later. Eliminate these blunders and the mortality would not have been high. Another reason why the mortality has been high, is because we have not approached this operation in a sensible way. If we will apply two pair of forceps to the duodenum as far as possible beyond the tumor and still sufficiently close to the latter to avoid injuring the common duct, we can cause a compression which will prevent any danger of hemorrhage from this point and which will facilitate the closing of the duodenum. We then apply another pair of forceps to prevent hemorrhage from the gastrohepatic omentum. The gastrocolic omentum is grasped in the same way. After these forceps have been applied a section is made of the duodenum between the first two pair of forceps which are left in place. If the malignant growth is confined to the tissues of the stomach the operation can be accomplished with great facility. A point to be borne in mind is, that the gastrohepatic omentum is to be removed. Therefore, we place successive pairs of forceps up to a point beyond the distribution of the lymphatics which communicate with the pyloric end of the stomach. There can be no hemorrhage because the blood supply comes from vessels caught by these forceps.

In doing this operation we must be careful not to injure

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the pancreas or to go too close to the transverse colon. If we bear these points in mind we can accomplish the operation safely in a short time. The pyloric end of the duodenum can be closed best by placing a simple purse-string suture about the duodenum. There can be no hemorrhage because this suture compresses all of the vessels. Then you take the lowest point you can select in the remaining portion of the stomach and attach it to the jejunum, leaving a sufficient portion free beyond the point at which the duodenum crosses the meso-colon to prevent all tension.

I think that with early operation and with these steps in view we should in the future have, not 5 or 10 per cent., but a very large proportion of permanent cures.

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THE SINGLE CUFF METHOD OF CIRCULAR ENTERORRHAPHY:

A NEW METHOD.

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A NEW METHOD.

A consideration of the evolution in the methods of circular enterorrhaphy occurring in the past seven centuries, with the use of mechanical devices and sutures, and by the suture methods alone, is indeed interesting.

The goose's trachea of the four masters, wood canula, dried intestine, Scarpa's tallow candles, Watson's gelatin tubes, Chopart and Sabatier's prepared cardboard, later, Senn's bone plates, Paul's bone tube, Ashton's rubber rings, Murphy's button, Jessett's bone tubes, Brokaw's segmented rubber rings, the potato cylinder, the forceps of Laplace and others, the rubber bulbs of Treves, represent the progress in mechanical devices; while the Glover suture and the open treatment of the wound, Jober's method, the Lembert suture, the Czerny-Lembert, the Maunsell method, Chaput's method, the Harris method, Kummer's method and the Connell suture, represent the progress in suture methods.

Considering the multiplicity of methods now in use, by mechanical devices and by suture, leads one to conclude that circular enterorrhaphy is still in an evolutionary state, that an ideal method had not as yet been devised.

Since Richat, Richerand and Treves, in the early part of the nineteenth century, taught that union is more readily obtained between serous surfaces than between

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mucous surfaces or beween serous and mucous surfaces, nearly all of the methods that have since been originated have adhered to the principle of obtaining union of serosa to serosa. The Lembert suture, placed through serosa, muscularis and submucosa with the knot outside of the lumen of the bowel, is probably the most universally popular method of suturing. Yet it must be admitted that closely placed sutures of this character in pathologic states of the bowel are often defective, because of pressure necrosis. The method is slow of accomplishment, also requiring great skill in placing the sutures through the submucosa without penetrating the mucosa. Should the mucosa be penetrated, a new danger is added, that of capillary oozing. By this method a diaphragm is formed within the lumen of the bowel, lessening to some extent its caliber. All of the methods in vogue which adhere to this principle produce a diaphragm within the lumen of the bowel, and some of the late methods have added to the danger of pressure necrosis, and have contributed a new danger in placing a foreign body within the lumen of the bowel, an occasional source of secondary leakage from necrosis, ileus, perforation and peritonitis.

Some of these later methods, however, possess the great merit of being time-saving measures, which must be recognized as extremely important in cases demanding resection of the intestine. Chaput, in 1889, developed an operation termed circular enterorrhaphy by abrasion and application, in which he coapts denuded mucous surfaces, demonstrating that permanent union may be thus obtained. Robinson, in 1891, in a paper entitled "Circular Enterorrhaphy by a New Method," demonstrated union between serosa and denuded mucous membrane. Robinson's method, as well as Chaput's, does not produce a diaphragm within the lumen of the bowel. Harris, in 1892, presented a method involving the same principles as Robinson's method, with, however, an improved technic, in that he does not use a

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foreign body within the lumen of the bowel. Harris has also, besides extensive experiments on the dog, applied his method to the human intestine, demonstrating sero-fibrinous union. The requirements to be met in an ideal method are:

1. The union of the severed ends of the intestine by a method which provides against immediate and secondary leakage from the intestine.

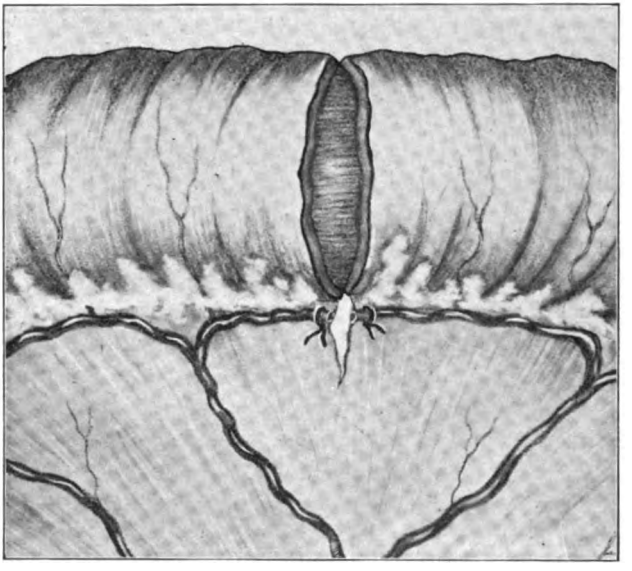

Fig. 1.—The mesenteric arteries are ligated, and a knife is passed through the mesentery and made to encircle the bowel, cutting through serosa and muscularis.

2. The method must be applicable to pathologic conditions, as well as to the normal intestine.

3. Lessening of the caliber of the bowel at the site of union should be obviated.

4. Rapidity of execution.

I wish to present a method which, in my opinion, meets all of these requirements. The character of union obtained is serofibrinous.

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DESCRIPTION OF METHOD.

The intestine is drawn out through the abdominal incision and its course determined. The contents of the intestine are stripped downwards and tapes or clamps applied. The mesenteric arteries are ligated. A knife is passed through the mesentery and made to encircle the bowel, cutting through serosa and muscularis. A cuff of serosa and muscularis five centimeters in length with the mesentery, is rolled back by means of gauze dissection on the distal portion of the bowel, which is well protected with gauze. The bowel thus denuded is severed at its distal end within one centimeter of the cuff. At the proximal end it is severed flush with the primary incision. Eight through-and-through sutures, the knots placed within the lumen of the bowel, unite the proximal end of the bowel to the denuded stump at the distal end.

The cuff is now rolled over the site of union on to the proximal end of the bowel and made secure by a suture placed through the mesentery close to the bowel and three interrupted sutures placed in the cuff through serosa and muscularis of the underlying bowel.

PRINCIPLES INVOLVED IN THE METHOD.

The cuff completely covers the sutures placed through the proximal end of the intestine and the stump of the distal end, so that leakage can not occur, as plastic lymph and blood agglutinate the cuff to the serosa of the proximal end of the intestine.

There can be no increase of tension on the sutures placed through the proximal end of the intestine and the stump, on the resumption of peristalsis, because of the rapid union between the cuff and the serosa of the proximal end of the intestine. The caliber of the lumen of the bowel at the point of union is unchanged.

ARGUMENTS IN FAVOR OF THE METHOD.

1. It is practical, easy of accomplishment and quick of execution.

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2. It is the most natural way of uniting the severed ends of the intestine.

3. The cuff so covers and protects the sutures placed through the proximal end of the intestine and the stump of the distal end that the direct line of leakage and infection is obviated.

4. Pressure necrosis and leakage is not probable, and union is quite certain, as the blood supply to the cuff and the proximal end of the bowel that is covered with the cuff is undisturbed.

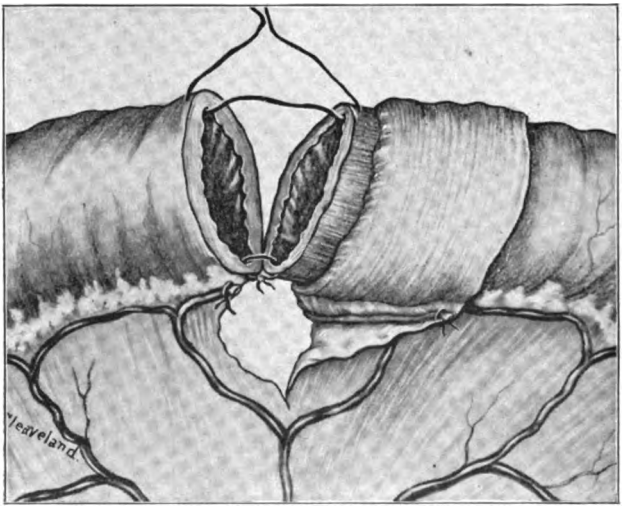

Fig. 2.—A cuff of serosa and muscularis with the mesentery is rolled back on the distal end of the bowel, by means of gauze dissection. The denuded area is severed at the distal end within one centimeter of the cuff, at the proximal end flush with the primary incision.

5. It is the most rapid of all methods, requiring but from five to eight minutes for its complete accomplishment.

6. It is the least complicated of any of the different methods now in use, and it can be safely performed by the ordinary surgeon, who rarely is called on to resect

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an intestine, quite as well as one greatly skilled in intestinal surgery.

7. Convalescence is more rapid and fewer post-operative sequelæ are likely to occur.

8. It is applicable to any part of the intestinal tract.

9. The security against primary and secondary leakage, furnished by the cuff, makes it the safest of all methods.

RESULTS OF EXPERIMENTS ON DOGS.

I will now submit a report of the pathologic findings following operation in specimens of union secured from dogs. There were four specimens examined, viz., two days, four days, eight days and thirty days, following the primary operations. The following is a report from the Columbus Memorial Laboratory, Chicago, by Prof. W. A. Evans:

SPECIMEN 1 (The two days' specimen).—This is a piece of small intestine, with mesentery attached. It is 5¼ cm. long. Near the center of the specimen is a discolored area 2¾ cm. long. Four circular incisions were made, one just above the discolored area, two through it and one just below it. A circular piece showing the convexity of the bowel was removed from just about the middle of the discolored area. At this point there is about ½ centimeter between the outer and the inner circular muscle coats. A second longitudinal section was taken through the line of juncture between the red and white at its proximal end.

SECTION A.—This is through the farther end of the cuff. Our sections are made lengthwise of the intestines. By microscopic examination we find the following: The mucous coat shows villi glands and other mucosa structures normal in every particular. The muscularis mucosa is normal. The submucosa is normal. It is rather thick just at the point of examination. This coat is quite thick, owing to it being the seat of a mucous fold. The circular muscle coat shows slight infiltration with leucocytes. The longitudinal muscle shows the same as the circular. Outside of the longitudinal muscle is a thin zone of mixed connective tissue fibers, fibrin, red and white blood cells. It is the union between the inner muscle tunic of the cuff and the serosa. It is as firm as it should be. This layer is about 1/10 as thick as the longitudinal muscle. Cuff circular coat is somewhat more inflamed than is the inner. Cuff longitudinal coat is somewhat more inflamed than the inner longitudinal. Cuff serosa does not show very well in sections.

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CONCLUSIONS.—Union is good between the cuff and the underlying intestinal wall.

SECTION B.—This is a section made from near where the mucosa and the submucosa of one side was stitched to the wall of the other side. Mucosa: This coat shows villi glands and other mucosa structures. It is quite normal. At four points just on the mucosa side of the muscularis mucosa there is a moderate inflammatory reaction around the thread fibers. There are some leucocytes among those fibers. The muscularis mucosa is in two coats. In the submucosa there is moderate inflammatory reaction, especially along the vessel radicles. One thread is partly in this coat and partly in the mucosa.

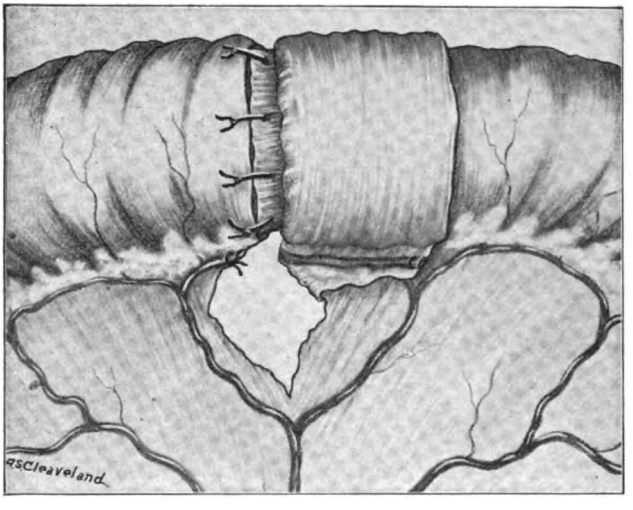

Fig. 3.—Eight through-and-through sutures are placed through the proximal end of the bowel and the denuded stump of the distal end.

INNER CIRCULAR MUSCLE.—This muscle shows one thread puncture just about its juncture with the longitudinal muscle. This layer shows a fair amount of inflammatory reaction along the vessel radicles.

LONGITUDINAL MUSCLE.—This shows about the same amount of inflammatory reaction as the circular coat. Outside the longitudinal muscle is the layer of fibrinous adhesions. This layer is four millimeters thick as it appears on the slide. It is composed of fibrin infiltrated with leucocytes and larger cells with considerable perinuclear protoplasm. In this district the thread shows at several places.

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CUFF.—Circular muscle fibers show considerable inflammatory reaction and extravasation of blood. The cuff longitudinal muscle shows much extravasation of blood and a fair amount of inflammatory reaction. The serosa, except for extravasated blood, is negative.

SPECIMEN 2.—This is a piece of small intestine with partial mesentery attached. It is 8 cm. long. Length of the discolored area in this specimen is 2 cm. The incisions were made just above the discolored area, 4/10 cm. below its upper border, 1 cm. lower down, and three other incisions each 5/10 centimeters apart.

SECTION A.—This extends longitudinally through the intestine at the tip of the cuff. The sections here show the same as

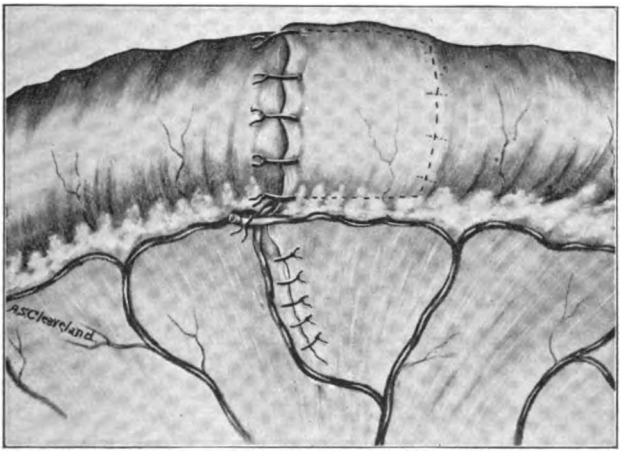

Fig. 4.—The cuff is now rolled over the site of union on to the proximal end of the bowel. A suture is placed through both folds of the mesentery of the cuff close to the bowel above the anastomosing branch of the mesenteric artery, and through both folds of the mesentery of the proximal end of the bowel. Three interrupted sutures are placed through the cuff into the serosa of the proximal bowel.

in the section marked "Section A, Specimen 1." The photograph shows a very good union, still fibrinous, between the cuff and the underlying intestine. The other layers are about as reported in Specimen 1.

SECTION B.—This is a semicircular section of the convex half of the intestine near the point of union of the mucosa and submucosa, to the mucosa and submucosa of the unstripped end. It is mucosa. The epithelial elements of the mucosa are perfect. In the connective tissue structure

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of the mucosa is more inflammatory reaction than in any section yet examined. The muscularis mucosa is in two coats, the longitudinal coat being the heavy one. The submucosa shows considerable inflammatory reaction. The circular muscle is filled with cells of inflammation, the fibers being considerably displaced. The longitudinal muscle shows the same as does the circular. The sections are evidently beyond the point of suture, i. e., in a region not split for the flap.

SECTION C.—These sections are just up the cuff from the line of suture of the mucosa. They show everything shown in "B" and in addition, external to the longitudinal muscle coat, is a coat of fibrous adhesion, and outside of this are the two muscle layers of the cuff.

SPECIMEN 3.—A piece of larger intestine than in the other specimens. The length of the piece is seventeen centimeters. The length of the discolored area is two centimeters. The bowel has been cut longitudinally just above the proximal end about 0.3 cm. below it, 0.5 cm. lower down, 1 cm. lower down, the last being outside the line of discoloration.

Sections were made as follows: A, longitudinal section through the cuff. B, the convexity of the bowel about the point of union of mucosa. B^1 near B.

SECTION A.—This is a longitudinal section near the tip of the cuff. The mucosa, muscularis mucosa, submucosa and longitudinal muscle are quite normal, showing very little inflammatory reaction. The line of union between the longitudinal muscle and the circular muscle of the cuff shows the following: The space covered is about 50 mikromillimeters. It is filled in by a loose reticular fibrous tissue. The fibers have no uniformity of direction. There are only a moderate number of blood vessels. These are young. There are many cells around the embryonal vessels. The vessels that I identify as such run lengthwise of the intestine. The two muscle coats of the cuff show about as much inflammation as the muscle coats of the intestinal wall. The serosa is thickened by inflammatory reaction until it is about as thick as one of the muscle coats.

SECTION B.—Longitudinal through the point where submucosa and mucosa of one side are joined to the intestinal wall of the other. The mucosa is perfect except for leucocytic infiltration. There is a deep V-shaped dip at the point of union, the apex being toward the muscle. Around the apex of the V runs the muscularis mucosa. The submucosa is also continuous. It is thin at the apex of the V. The circular muscle of the side is continuous and into the other. This is true of the longitudinal muscle and the serosa. The muscle coats of the other side come into the inverted V and turn up to form one of its sides.

They are joined to the circular muscle of the other side by a small amount of fibrous tissue. (The threads are knotted in

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the lumen and are firmly held in the wall.) All of the coats contain large numbers of leucocytes.

SECTION B.[1]—Circular beyond the line of sutures. This shows as indicated for Specimen 2, except that there is greater leucocytic infiltration in each of the coats.

SPECIMEN 4.—This was a piece of intestine, split longitudinally. Microscopically we do not find any evidence of the operation procedure, though this is probably due to our not finding the proper area for section. There is a heavy wall of the

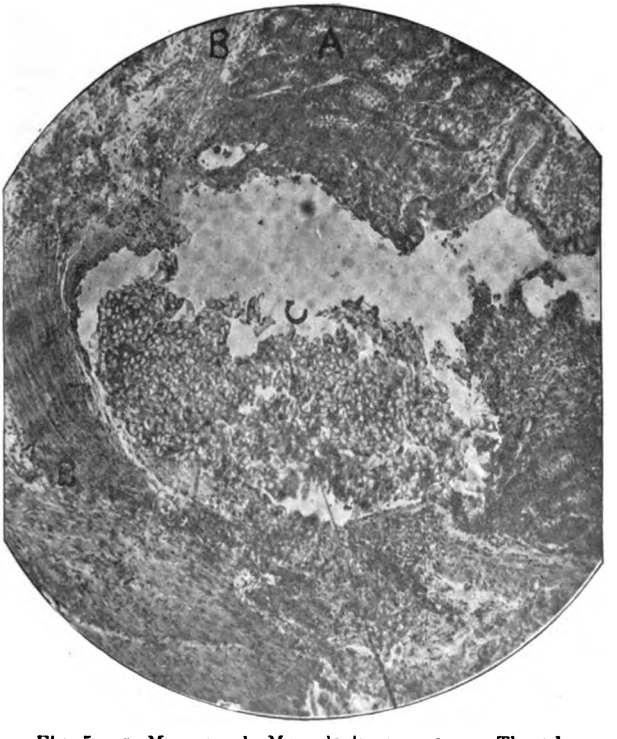

Fig. 5.—*a*, Mucosa. *b*, Muscularis mucosa. *c*, Thread.

usual coats. One half or more of the specimen has a serous coat that shows some peritoneal thickening. The other portion is not so covered.

EXPERIMENTS ON DOGS.

I have performed 75 primary operations on dogs, with the following results: 72 dogs recovered and 3 died, a

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mortality of 4 per cent. The convalescence in every case was short, the dogs being in every instance turned into the general ward at the end of forty-eight hours. The following is a report of the cases that died:

CASE 1.—Dog No. 36 died five days following operation. Cause of death was general peritonitis. The great omentum was infiltrated with blood and pus, and was adherent to the cuff. Free pus was found in the peritoneal cavity. The intestines were not much distended, but were agglutinated together in several places. The site of operation showed the cuff rather dark, but union of the cuff to the underlying bowel wall macroscopically seemed good. A section of intestine involving the site of union was removed, and examined macroscopically, but no evidence of non-union was discovered. The intestine was gently distended with water, but no leakage was found. The cause of death was believed to be an infection from without, due to a faulty technic.

CASE 2.—Dog number 48 died four days following operation. The cuff was distended with blood and pus, a perforation was found in the cuff in the line of union of the proximal end of the bowel to the stump, with positive evidence of leakage.

CASE 3.—Dog No. 62, died thirty-six hours following operation. No evidence of peritonitis. The appearance of cuff was good, and was seemingly well adhered to the underlying bowel wall. On section the intestines were found quite well filled with blood, showing that death was due to hemorrhage.

Thirty dogs were reoperated on at periods varying from two to thirty days following the primary operation, with two deaths, a mortality of 7.5 per cent. The deaths occurring in dogs operated on at the end of forty-eight hours following the primary operation, and in each instance within twenty-four hours.

CONDITIONS OF THE CUFF FOUND.

In nearly every instance there were slight adhesions of the omentum to the cuff. The union of the cuff to the underlying bowel was good in every instance. In one instance the intestine above and below the cuff for a distance of five or six inches was adherent, making a bend in the intestine just below the cuff, but in no way obstructing the lumen of the bowel. In every respect the results were universally good.

WORK ON THE HUMAN.

I have only used this method in two cases, in the one

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a somewhat modified technic was followed, in the other the same technic, as above described, was adhered to.

CASE 1.—Mr. B., 50 years of age, was operated on Feb. 6, 1903, for the removal of a tumor in the region of the sigmoid flexure of the colon. The tumor, with several inches of the intestine, was removed. The proximal end of the intestine, which was to be covered with the cuff, was denuded of its serosa, so that the cuff came in direct contact with the muscularis. The patient made an uninterrupted recovery. The tumor removed proved to be an adenocarcinoma.

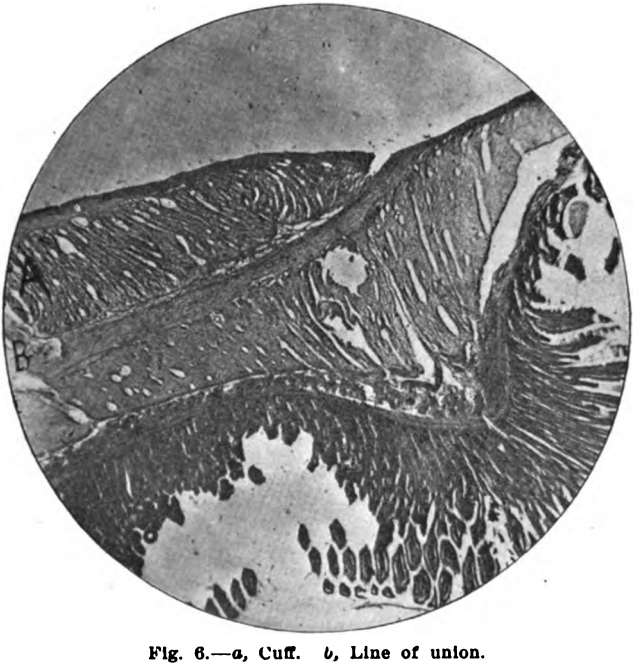

Fig. 6.—*a*, Cuff. *b*, Line of union.

CASE 2.—Miss B., aged 20, had been operated on by the writer five months previously for the relief of chronic obstruction of the bowels, due to tubercular peritonitis. The patient was relieved of the obstruction, improved in general health, and it seemed for a time that her ultimate recovery was assured. Feb. 1, 1903, about five months following operation, she again developed pronounced symptoms of intestinal obstruction. Her condition grew worse from day to day, although slight bowel movements were secured by the use of the high rectal tube. February 12 she had stercoraceous vomiting, and a fecal dis-

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charge made its appearance in an abdominal fistula remaining from the previous operation.

Although the condition of the patient could hardly be more extreme, and but little hope could be given her of an operation benefiting her, yet she was desirous of the few chances that it might offer. The abdomen was opened in the median line. The intestines were greatly distended and very much adherent to the parietal peritoneum, and greatly matted together. The site of obstruction was searched for and found. The fecal fistula was located, the intestine just above the site of obstruction was perforated in two different places, so that it was necessary to resect about six inches of it, as it was impossible to attempt its repair. There was no difficulty in obtaining the cuff, the above described method being practiced in every detail. The time occupied for the complete resection was ten minutes. In the further liberating of the adherent intestines a large tear was discovered in a badly ulcerated area, and a second resection of probably four inches of intestine made.

The second resection was a little more difficult on account of adhesions and the extensive pathology in the mesentery; however, it was accomplished in a reasonably short period of time. The patient died at the end of thirty-six hours. A postmortem was denied, so that we can not say as to the behavior of the parts of the bowel united.

The method of operating had nothing to do with the results in this case, as it was evidently hopeless by any method of procedure. It has, however, demonstrated that a cuff can be readily formed of pathologic tissue and that the method is applicable in all cases where resection of the intestine is necessary.

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INTESTINAL RESECTION,

WITH A REPORT OF SIXTEEN CASES: NINE WITH THE MURPHY BUTTON AND SEVEN WITH THE SUTURE.

JAMES H. DUNN, M.D.
MINNEAPOLIS.

With the exception of small lesions toward the free border of the tube, surgical repair of the intestines usually implies a resection more or less extensive, hence the title intestinal resection has seemed more nearly descriptive of the matter on which it is my purpose to elicit discussion than the more usual term "intestinal anastomosis."

Every surgeon who undertakes even cases of strangulated hernia, intestinal obstruction or penetrating wounds of the abdomen, as well as all who open the abdomen for whatever cause, must be prepared to face, often in the most unexpected manner, a resection or repair of the intestinal canal. In the vast majority of cases intestinal surgery is decidedly emergent. The urgent nature and comparative rarity of such operations in any one surgeon's practice renders a perfect technic exceedingly difficult. To skilfully execute such an operation on a moment's notice under the most varying conditions, and perhaps at rare intervals, is a severe task. These considerations lend the subject a somewhat general interest, and place it among those topics which may be frequently discussed with profit even though nothing new be brought out, every surgeon having reason to frequently review his knowledge and rehearse his technic.

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The first difficulty one meets is the great multiplicity of methods and the almost endless novelties of technics and operations from which to select. With the mind so full of many theories, and the preparatory drill spread over endless ways, the operator is in the worst possible condition to meet an emergency. Have we not arrived at a point where we can stop investigating new frills and settle on the simplest procedures with advantage?

During the past six years I have had occasion to resect the intestine 16 times, as follows: For strangulated hernia, 3; for fecal fistula, 3; for sarcoma of the small intestine, 2; for carcinoma of the cecum, 2; for carcinoma of the sigmoid, 2; for intussusception, 1; for gunshot wound, 1; for injury during operation, 2. In these the Murphy button was used 9 times, with 3 deaths; the suture 7 times, with 1 death.

The somewhat prodigious number of methods for uniting the bowel may be first divided into three general classes: First, mechanical appliances, to remain in the intestine; second, pure suture methods; third, special appliances to facilitate suture, and then to be removed.

The latter class, to say the least, belongs to those things which are more ingenious than necessary. For my part I do not use them, for many reasons, one of which is perhaps quite sufficient, viz., as good work may be done more conveniently without as with them.

Mechanical means versus the suture in intestinal anastomosis is often debated pro and con. As a simple general proposition, this is manifestly unjust. Possibly all anastomoses may be made by the suture, but certainly in some localities and under some conditions a mechanical means is occasionally preferable. On the other hand, there are many situations and conditions to which mechanical anastomosis is entirely unfitted. Therefore, I conclude that the minimum of methods for good intestinal work is a good mechanical and a good suture method. The practical surgeon will therefore select what he believes to be the best mechanical method

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and the best suture method, master all the details of each, and be prepared with materials and by occasional rehearsals for the skilful execution of the method best adapted to the situation.

UNION BY MECHANICAL MEANS.

Doubtless any one of several buttons, bobbins, mats or what-not, may be used with more or less success, but increasing experience shows the Murphy button to be on the whole the most practicable. It is cheap, easily preserved indefinitely in readiness and has been used with success and increasing frequency in all parts of the world. Whatever theoretical objections may be conjured up against it, it has probably more success and as few failures to its credit than any other method of anastomosis, when applied properly to proper cases. Of my 9 resections with union by the Murphy button 3 died. One, Case 6, would surely have died despite any method of anastomosis. In one case, No. 9, I was led by the almost moribund condition of the patient to use the large button in an end-to-end union of the sigmoid, though it is generally recognized that the large intestine is not safely united by the button. This death, if due to any operative fault, in no way condemns the button for use in proper cases. In one case, No. 7, an end-to-side anastomosis after resection of the cecum for a very large carcinoma, in a very fat and flabby woman, the death from sepsis and nephritis on the thirty-first day, long after the button had passed, and without any bowel disturbance, makes it probable that the method of union was not at fault. In Case 5 a temporary fecal fistula followed the use of the button in an end-to-end anastomosis of the small bowel, for sarcoma. I have reason to believe that the fistula took place at the mesenteric border. The mesentery was considerably thickened and some difficulty was found in properly adjusting it within the button. Under these conditions either a very much larger amount of intestine should be resected or the suture used instead of the button. The

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ultimate result in the case has been entirely satisfactory so far as the anastomosis is concerned. In the remaining five button cases the immediate and subsequent course was without any complication.

The duodenum, owing to its fixed position and lack of peritoneal covering, is naturally excluded from end-to-end anastomosis by the button. The large intestine, for many reasons, both anatomic and physiologic, is not adapted to anastomosis by mechanical means. It is less richly supplied with blood vessels, its walls very variable in thickness, the appendices, epiploicæ and its mesentery often thickened and clumpy with fat and considerable portions not covered by peritoneum. Its contents are much thicker and more liable to block mechanical contrivances and its peristalsis comparatively feeble. Hence, with the exception of end-to-side anastomosis between the small and large intestine, the suture should practically always be used. In the unfixed portion of the small intestine, a good union is possible by either button or suture, but, on the whole, I believe the button anastomosis has the most points of excellence: First, it may usually be executed somewhat more rapidly; second, if skilfully applied is evidently primarily as safe in this location as suture. Third. After the button has passed the intestinal wall is left in better condition than by suture. In all suture methods where silk is used there is either for a long time or permanently left in the bowel material with decided possibilities of trouble. With the button, the primary healing once over, the most perfect conceivable condition is usually left and the condition is uniform. As much can not be said of any suture in any case and the results are materially far from mathematically uniform, even in the same surgeon's cases. The most skilful operator will vary a little in the amount turned in and in the regularity of his suture. The mechanism once properly placed cuts by its pressure to the same line. The objections to the button in this locality are mostly theo-

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retical or drawn from very exceptional ill results or cases of faulty technic. When it may be said that any other method is absolutely perfect and without occasional mishap, the practical surgeon may give greater weight to the theoretical objections of a foreign body in the intestine, to isolated failures to pass, or to exulceration of the button, despite the many hundreds of successes at the hands of hundreds of surgeons, many of those of little experience, and the growing tendency of many of the very greatest surgeons at home and abroad to use this method in appropriate cases.

UNION BY SUTURE.

The suture has a much wider application. It may be used in practically all cases to which the button is applicable. In the duodenum and in the large intestines it has for anatomic and physiologic reasons practically the whole field. Hence a surgeon may nearly or quite dispense with mechanical means of anastomosis, but a good suture method is a necessity. While we undoubtedly owe a very large measure of our success to experimental work and the fundamental principles have been thus established, yet experimenters have borrowed an enormous amount of unnecessary trouble about lesser matters of which Nature takes little notice. The necessity of peritoneal approximation, the length of intestine which may safely be resected, the degree of narrowing which is permissible, the difficulties of the mesenteric border, etc., were early elucidated and are essential, but the fears of penetrating all the coats and the special dangers of the knot of elbowing in order to increase the caliber, etc., have been considerably overdone. I feel sure from much personal observation—having followed up individuals for years whose intestines were closed up with very rudimentary needlework—that the fears of some experimenters are not entirely well founded.

Of the 7 unions by suture, 4 were by the Connell method. The Connell suture appeals to me as by far the best suture up to date; first, a continuous suture is the

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safest; second, penetrating all coats it is the strongest and surest; third, it is a simple set procedure, capable of an unvarying technic from start to finish, with no change of stitch, and no apparatus but needle, thread and fingers; it is capable of greater rapidity than any other method except the button—the easiest and simplest of all, except at its finish. The closure of the last third, and especially of its last stitches, is, of course, somewhat difficult, but after sufficient drill probably not much more so than some part of any competent intestinal suture. It takes the best care of the weak point, the mesenteric border, while the gut is open. With one exception it is, for me, the *ne plus ultra* of intestinal sutures, viz., experimental work and autopsies show that for a very long time, at least two or three months, the thread remains encircling the bowel wall or hanging into the intestine. While I am unable to point to any serious result demonstrably having followed this state of affairs, it is certainly not an ideal condition, and one which would seem pregnant with as many pathologic possibilities as the shorter stay of a foreign body in the case of a button. It is quite startling to find at the autopsy, thirty-one days after the resection, so much thread imbedded in the whole circumference of the otherwise beautifully restored bowel, as was observed in Case 13.

All the unions were end to end, excepting the two resections of the cecum, where end-to-side anastomosis was employed. When the resected ends can be easily approximated without tension and the mesentery is in a normal condition, end-to-end union would seem to be preferable to lateral anastomosis, as it more nearly restores the organs to normal conditions. Pathologic changes in the mesentery may sometimes render it desirable to close the ends by purse-string sutures and make a side-to-side union. When this is done with but little overlapping so that the blind ends are very short, antiperistaltic union is probably without very serious

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objection. However, an isoperistaltic union would seem preferable whenever practicable under all circumstances, and quite necessary if the blind ends are of much length. In resecting median portions of the small intestine, it is often difficult to quickly establish with entire certainty which is the proximal and which the distal limb of the loop. If an end-to-end union is to be made this is of no consequence, but in case of a lateral approximation it calls for a decision which further complicates the operation. I would therefore not choose lateral anastomosis except in cases in which some pathologic or anatomic condition of the mesentery rendered the end-to-end approximation unsafe.

CONCLUSIONS.

1. Suture is the most indispensable and generally applicable method of anastomosis in intestinal resection.

2. The Murphy button is equally useful, if not preferable, under certain conditions, but very inferior under others. For the end-to-end union of segments of normal small intestine, or the end-to-side anastomosis of healthy small and large bowel, it gives results unexcelled by any other method. In unions of the larger intestine it is so far inferior to suture as to be practically contraindicated. Pathologic changes in the small intestine or its mesentery which render the perfect application of the button difficult or such as would probably disturb the course of healing, should be united by suture.

3. Of suture methods that of Gregory F. Connell is incomparably the best; is, in reality, the simplest; a single row of continuous suture, all within the gut, the most likely to be even, strong and tight, with the smallest and most even diaphragm, admits of the easiest and most perfect dealing with the mesenteric border and is capable of a simple invariable technic.

4. It is especially desirable to choose the fewest and

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simplest means compatible with the best work, because intestinal operations occur at rare and irregular intervals as emergencies in the hands of many surgeons, and the little conveniences which enter into highly specialized operations of repeated daily execution are for the most part worse than impracticable.

NARRATION OF CASES WITH USE OF BUTTON.

CASE 1.—Miss H., age 27. Strangulated femoral hernia. Operation only twelve hours after onset of symptoms. Three inches of small intestine gangrenous. Resection of five inches; end-to-end anastomosis with Murphy button. Prompt recovery. The button passed on the eleventh day. No return of hernia. Now, six years after, health perfect.

CASE 2.—Fecal fistula from inflamed umbilical hernia. Mrs. B., aged 46, enormously fat, had a large umbilical hernia of ten years' standing. Three months before coming under my observation symptoms of inflammation and finally of intestinal obstruction had appeared. After eleven days of expectant treatment an abscess had broken through and pus and feces had discharged. A large fecal fistula had since discharged nearly all the bowel contents, only occasionally a little passed per anum. The abdomen was opened, the adhesions separated, the hernial sac and a portion of the omentum was removed. and three inches of small intestine resected. End-to-end union with the Murphy button and radical cure of hernia with silver wire. A large area of eczematous skin around the fistula was excised and the skin closed transversely. The button passed on the ninth day. The recovery was uninterrupted, excepting a slight superficial infection, which did not lead to removal of the deep wire sutures. Her health has remained good, no relapse of hernia and no trouble from the wire sutures at last observation, four and one-half years after operation.

CASE 3.—Fecal fistula. Mr. M., a farmer, aged 32. Had right inguinal hernia of long standing. About five weeks before coming under observation strangulation occurred, and Drs. DuBois and Hilbert of Sauk Center operated, after which the patient did well and was entirely relieved for ten days, when symptoms of strangulation again suddenly appeared. After a week of vomiting and inability to pass gas or feces, Drs. DuBois and Hilbert reopened the wound and incised a knuckle of adherent small intestine forming an artificial anus.

The patient then again did well for two weeks, when obstruction again, for the third time, became complete. I was then called by Dr. DuBois. The patient's general condition was now bad. He was emaciated and weak, and the operative field was rendered uninviting by recent operations and the recent fecal discharges which had constantly bathed and irritated the skin for two weeks. The operation was made at the

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patient's cottage under poor surroundings. On reopening the abdomen it was found that a small knuckle of intestine which was attached to the abdominal wall and the seat of the artificial anus had twisted on its axis, leading to complete obstruction. This loop was resected and an end-to-end anastomosis made with the Murphy button. The abdomen was closed with figure-of-eight silkworm-gut sutures, and the patient made an excellent recovery, with only some slight suppuration in the wound. The conditions for primary union were as unfavorable as could be imagined. I examined the patient two years after the operation and he was well and free from hernia.

CASE 4.—Gangrene due to strangulated hernia. Male, laborer, aged 28. City Hospital. The patient entered with a large inguinal hernia, strangulated since six days. The scrotum was red, swollen and inflamed and the patient profoundly septic. On opening the sac about three feet of small intestine was completely gangrenous. Resection of three and one-half feet. End-to-end anastomosis with Murphy button. The wound was left partly open and the wound and abdomen drained. Death followed in forty-eight hours, due to peritonitis and sepsis. Postmortem showed the anastomosis to be perfect, and that the button was in no way responsible for the death. Probably it was a mistake to have resected at all. Under such conditions again I would lay open the sac without a general anesthetic, and if the patient recovered make a subsequent resection, as in Case 2.

CASE 5.—Sarcoma of small intestine. Mrs. B., musician, wife of a physician, aged 44. In August, 1896, she began to have looseness of the bowels, and ever since off and on had had spells of looseness, becoming worse each year. In November, 1902, she had a very bad diarrhea, which reduced her strength and weight very rapidly. This diarrhea was of a peculiar character, i. e., it was worse after lunch and still worse after dinner and all night, but from 9:30 a. m. to 1:30 p. m. it was not very troublesome. There were usually from eight to ten movements a day. There was no pain, but a very great quantity of gas was passed, the feces very thin and horribly offensive and of the consistency of muddy water. She was very anemic, greatly emaciated and weak.

I first saw her on the first of February, 1902, and on physical examination could distinguish a mass to the right of the uterus and attached to it, which was apparently of the size of a small fist. I suspected the bowel was involved in this mass, and advised exploratory incision. The operation took place at St. Barnabas' Hospital, Feb. 12, 1902. On opening the abdomen this mass was found to consist of a very much enlarged and dilated coil of small intestine attached to the uterus. The mesentery of the intestine was also infiltrated and thickened. I removed eight inches of the intestine and its corresponding mesentery and made an end-to-end anastomosis with

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the Murphy button. The patient did remarkably well for a few days, but on the twenty-first she developed some temperature. The abdominal wall was opened slightly and a fecal fistula made its appearance. For a few days a large quantity of feces was discharged through this wound. March 4 the patient insisted on being taken in the ambulance to her home. On March 6 the button was passed, and March 11 the fistula closed permanently, and she was up and about the house March 21, from which time she made a fairly satisfactory recovery.

The portion of intestine removed was believed on gross appearances to be a chronic inflammatory process and the specimen was sent to the laboratory of the University of Minnesota. Professor Wilson reported it to be a sarcoma. The patient is still—thirteen months after the operation—in very good health. At the time the union was made considerable difficulty was experienced in bringing the somewhat clumsy mesentery satisfactorily within the button, and I remember using an extra stitch through the mesenteric border and tying it around the button stem. This was doubtless the point where the fistula took place. It might have been better to have resected a much longer loop, thus securing a more normal mesentery or to have used the suture at the point chosen.

Case 6.—Carcinoma of cecum. Mrs. S., aged 36. For several months has complained of pain and tenderness in right inguinal region and of alternating constipation and diarrhea. There is a tumor in the region of the appendix and the condition thought to be some anomalous form of appendicitis, perhaps tubercular. On operation, carcinoma of the cecum was found. About six inches of the ascending colon, the cecum and four inches of the ileum resected. End-to-end anastomosis with the Murphy button. Uninterrupted recovery and health good when last seen, one and one-half years subsequently.

Case 7.—Carcinoma of cecum. Mrs. L., French, aged 38. Mother of six children, youngest 2 years of age. Previous health excellent, excepting loss of control of bowels from a complete laceration of the perineum. She now wished this repaired, as she had been led to believe it was the cause of her present illness. About one and one-half years ago she began to have pain and diarrhea in the morning, with nausea and pain in the stomach. On examination I found a large woman, a very fat abdomen, and a very large, hard tumor, much larger than two fists, in the right iliac region. Complete laceration of the perineum. Diagnosis, probably carcinoma of the cecum.

Ten inches of the cecum and ascending colon and a portion of the ileum was resected with much difficulty, owing to the advanced stage of the very large growth. End-to-end anastomosis with the button. The button was found in the vagina five weeks later. For two weeks the patient did very well, she then developed temperature, suppuration in the large and

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deep external wound (the fat was about four and one-half inches thick at this point) and nephritis, dying seven weeks after the operation. No autopsy was permitted, but the death was clearly not due to the method of union, nor, indeed, to the anastomosis at all. The enormous wound in an obese and bad subject became infected, and sepsis and nephritis finally exhausted her resources.

CASE 8.—Strangulated femoral hernia. Mrs. M., aged 46, German. Had been ruptured for several years, and for the last two years the tumor had been irreducible, hence, despite symptoms of strangulation, the patient and her family physician had refused to look on the hernia as the cause of the constant vomiting until the fourth day, when I was called in consultation, and insisted on immediate operation. The sac was chiefly filled with adherent omentum, but a very small knuckle of small intestine had recently slipped in, become strangulated and was found gangrenous. Resection of three inches. End-to-end anastomosis with button, drainage of external wound. Prompt recovery.

CASE 9.—Stenosis of sigmoid from very small annular carcinoma. Mr. B., laborer, aged 45. Entered St. Mary's Hospital in March, 1900, complaining of a recent right femoral hernia, on which I operated, finding the appendix vermiformis and some omentum in the sac. The appendix, omentum and sac were removed, and he made a good recovery. While at the hospital it developed that he had had some slight difficulty in getting his bowels to move satisfactorily, but this seemed to be better on taking some laxative, and he left the hospital at the end of three weeks.

I saw nothing further of him until July, 1901, when I was called by his attending physician, Dr. Ringnell, and learned to my surprise that he had been having increasing trouble with his bowels since leaving the hospital, until of late he was having frequent attacks of complete obstruction, lasting for days at a time and in the intervals getting liquid movements with great difficulty. He was greatly emaciated and thin and seemed almost *in extremis* from pain, vomiting and distension. Chronic obstruction in the lower large bowel was diagnosed and immediate operation urged. The patient, however, stubbornly refused until September 1, when he consented to return to the hospital. He was then very weak and death very near. On opening the greatly distended abdomen a very small annular growth in the sigmoid, less than an inch in extent, was found, reducing the caliber of the intestine to that of a very small lead pencil. The gas and liquid feces were evacuated by introducing a glass tube into the intestine above the growth, and about four inches resected. On account of the almost moribund condition of the patient I chose the large Murphy button for making the end-to-end anastomosis. Death from peritonitis and sepsis in thirty-six hours. Autopsy showed

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button plugged and a leak from distension. The first mistake was the patient's in refusing operation for months after it was clearly necessary and strongly advised, the second in using the button under these conditions where suture is always indicated.

Thus of the 9 cases united by the button, 3 died, 1 clearly because no resection should have been undertaken—the patient probably would have succumbed in any event, but the only hope would have been in incision of the sac, which might have been done without anesthetic. In one the larger button was used in an end-to-end anastomosis of the sigmoid, and although the patient was in extremis it is quite possible that he might have recovered by the suture. This is the only case in which I have to regret the method of anastomosis chosen. One dies six weeks after operation, with extraperitoneal suppuration in the abdomen and nephritis. There is no reason to believe the method of anastomosis had anything to do with the result.

NARRATION OF CASES OF UNION BY SUTURE.

Case 10.—Intussusception, necrosis at the neck. A boy, 6 years of age, symptoms of obstruction for eight days. Dr. Glenn was finally called and diagnosed intussusception. On opening the abdomen a large quantity of rather dark serum escaped. About a foot of the ileum invaginated into itself. The neck was at about the point of Meckel's diverticulum, of which there appeared to be a remnant. The invagination was reduced with considerable difficulty and a small necrotic area at the neck necessitated resection of a small portion of the gut. End-to-end anastomosis—Czerny-Lambert suture. Recovery without complication.

Case 11.—Pistol wound of abdomen. W. J., aged 23. Shot in the abdomen with pistol at short range. Wound of entrance two inches to the right and a little below the umbilicus. No wound of exit. Operation twelve hours after injury. Seven perforations of small intestine, closed with continuous Lembert suture. Resection of twelve inches on account of injuries at the mesenteric border. End-to-end anastomosis with Czerny-Lembert suture. Recovery and perfect health two years after.

Case 12.—Sarcoma of the small intestine and uterus. Mrs. M., German housewife, aged 38. In May, 1901, was taken with cramps in the bowels, pain radiating toward the center. She vomited for eight days more or less and there was much distension and gurgling in the bowels, and irregular diarrhea dur-

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ing the past four months. On examination a considerable tumor attached to the uterus could be made out. It was fairly movable and had been mistaken by several for a fibroid of the uterus. I was not just clear what the condition was, but believed it was primarily uterine with attachment to the bowel, and advised an exploratory incision.

Sept. 7, 1901, the abdomen was opened and a loop of small intestine about ten inches long and its mesentery was found involved in a new growth. This mass was firmly attached to the uterus, which was also invaded by the growth. Recognizing the condition as malignant and probably past successful removal, a side-to-side anastomosis of the two limbs of the loop of intestine above the growth was undertaken. After the button was introduced it was found defective and had to be taken out. I then decided to remove the growth and some sixteen inches of small intestine and its mesentery, the uterus, tubes and ovaries, and a portion of the base of the bladder, which were resected in one piece. End-to-end anastomosis of the resected intestine by Connell suture. The time of the whole operation from entering to leaving the operating room was one and one-half hours.

The patient made a good primary recovery, leaving the hospital twenty-seven days after operation to go to her home in Dakota. Her health was greatly improved for some months. Six months later the growth returned and at last reports she was failing rapidly. The specimen removed was submitted to Dr. White of the pathologic laboratory of the University of Minnesota, who reports it to be a lympho-sarcoma of the small intestine.

Case 13.—Mr. H. Carcinoma of the sigmoid flexure of the colon; resection of six inches; end-to-end union by the Connell suture. The patient's health had been excellent until about one and one-half years ago, when he began to experience considerable difficulty in moving the bowels, obstruction symptoms not very severe until the past four months; he has attacks of pain before the bowels move, and for the past six weeks it is with great difficulty that they can be moved at all. By taking much physic and repeated enemata he is enabled to overcome the obstruction. The diagnosis was partial obstruction in lower colon, probably from carcinoma. March 4, 1902, resection of six inches of the sigmoid and end-to-end anastomosis with the Connell suture. The abdominal wound became slightly infected superficially with colon bacillus and discharged moderately for ten days, otherwise the after-course was uneventful. March 31 the patient was apparently well, having been up and dressed for two days. He had made all arrangements to leave the hospital for his home, some two hundred miles distant, on the following day, when he was seized with an apoplectic stroke, from which he died April 4, thirty-one days after the operation. Autopsy showed the operation

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wounds perfectly healed and the anastomosis was perfect with no intraperitoneal adhesions. On dissecting the intestine the whole suture was found intact in the walls of the intestine, forming a circle entirely around it. None of the stitches had so far been thrown off into the bowel.

CASE 14.—Gangrenous strangulated hernia. Sister A., a Little Sister of the Poor. Had a slight femoral hernia of long standing which had been strangulated for at least twenty-four hours. Several unsuccessful attempts at reduction by taxis had been made. On opening the very large sac about ten inches of small intestine was found to be gangrenous. As it was difficult to bring down a sufficient amount of bowel to make a good resection without cutting through Poupart's ligament, the abdomen was opened by a second incision above the ligament in the outer border of the rectus muscle, the operative field in the abdomen well packed off with gauze, the loop drawn into the abdomen and brought out through upper incision, and twelve inches resected. End-to-end union with Connell suture. The hernial sac then removed and hernial wound closed as usual. Uneventful recovery, patient leaving hospital seventeen days after operation.

CASE 15.—Mr. M., a young German farmer, when seen had obstruction of the bowels for four days. His condition was said to have been good until the last six hours, since which he had rapidly collapsed. He had had two very severe attacks of appendicitis ten years before, since the last of which his health had been excellent, until the sudden onset of symptoms of intestinal obstruction. Patient evidently failing rapidly every hour—cold extremities, rapid, feeble pulse, great distension. Nevertheless, the abdomen was opened at his desire. The small intestines were found bound down into the bottom of the pelvis by broad bands, so much so that they appeared to have a mesentery on both sides. The distended intestines could not be turned out of the abdomen on account of their attachment to bottom of the pelvis, hence there was great difficulty in dividing the bands. A knuckle of intestine was so injured that resection of about two feet became necessary, hurried end-to-end anastomosis, with Connell suture rather imperfectly done and reinforced at last third by continuous Lembert. Patient expired within an hour. It is needless to say the result has no bearing on the method of anastomosis.

CASE 16.—Mrs. J., aged 32. Had a violent appendicitis and pelvic suppuration some months previously. The abscess had been drained, but appendix not removed. Recovery never complete. At secondary operation intestines matted together in bottom of pelvis by old, well-organized adhesions, small pelvic abscess; appendix removed and many bands and adhesions severed, finally one knuckle of intestine so injured in several places that resection was deemed safer than isolated repairs in its diseased condition. Resection of almost six inches of small

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bowel, end-to-end anastomosis, Connell suture. Pelvic drainage. Recovery without complications.

Of the 7 unions by suture, 6 recovered; 4 were by Connell suture, with 1 death from collapse within one hour.

DISCUSSION

ON PAPERS OF DRS. CAMPBELL AND DUNN.

DR. A. F. JONAS, Omaha—The indications for this operation are so plain that they need no discussion, but the methods for doing an end-to-end approximation is a question that involves a multiplicity of ways. The inventive genius seems to be so prominent in American surgeons that no sooner has some one proposed a new method for the relief of any particular affection than the American man is not satisfied to try that particular method, but he immediately goes to work and tries to invent a method, hoping to get something better and something newer. For my own work I have only employed two methods; the first is the mechanical device practiced by Murphy, the second the simple suture. I desire to call attention to four points: The first is to get the approximation of the intestines at the point where it joins; the second, to leave no knots on the outside of the intestines; third, it must be watertight; and, fourth, it must be airtight. Now, with these four things carefully carried out, in a practice requiring a simple form of technic, the simple suture will be the best to use. The only way to do surgery is first to study the pathology, and in the operation do not use any methods that will lead to this pathology in the smallest possible way; if possible, do not use any mechanical devices for the purpose of holding the intestines in position.

Some years ago, Nicholas Senn described in THE JOURNAL of the American Medical Association, fifty or more appliances for the purpose of producing end-to-end union. Of all this long series, there is probably only one that is used to any extent at the present time, and that is the Murphy button. Of all the many sutures with which I have become familiar I employ none but the Connell suture, as it is the most easily applied, most satisfactory, gives the best results and leaves the knots all on the inside, thus giving no opportunities for the subsequent formation of adhesions in the intestines. All the forms of sutures which leave the knots on the outside favor adhesions with the other parts of the intestines, or with other organs necessitating secondary operation. In order to properly apply any form of intestinal suture we need to practice that form more or less constantly. To do the operation with the Connell suture will require a certain amount of preliminary practice as with any other suture. It is practically impossible for any man to stand beside the operating table and see anyone else perform an operation and then go home and do the work with-

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out preliminary practice. What would you say if a tailor simply stood beside another tailor and watched him apply the stitches to your coat? Would you then expect him to make seams accurately and firmly? Why should you expect any more a man to be able to suture an intestine simply from what he reads in books or from standing beside another operator? The Murphy button, simple as it is in its application, must be practiced primarily on the dog, and certain details must be memorized before its use can be undertaken in the human subject. My plan is to use the Murphy button in all cases where the structures can be snugly drawn together between the two parts of the button. Where the structures are too thick, such as the large intestines, I employ the suture method. So far as Dr. Campbell's method goes, I have the objection to it that he still leaves the knot on the outside.

Dr. J. Shelton Horsley, El Paso, Texas—In regard to the term "intestinal resection," it seems to me there might be still further improvement. Resection means simply cutting out a portion of the intestinal canal, and has no reference to the subsequent joining of the divided ends, which is really the main and most important portion of the procedure. "Intestinal anastomosis" is also objectionable when applied to an end-to-end union. Anastomosis means that an obstruction in the main channel is compensated for by some more or less indirect route, as in the case of small branches of blood vessels taking up the circulation when there is an obliteration of the main channel. When, however, this obstruction in the main channel is removed and the direct current re-established, as in the case of end-to-end union in intestines, the term anastomosis is clearly inapplicable. "Circular enterorrhaphy" means merely suturing of intestine in a circular manner. In the operation for prolapse of the rectum, in which after abdominal section a portion of the sigmoid is drawn up and sewed to the abdominal wall, if this sewing is done in a circular direction, the term "circular enterorrhaphy" could most assuredly be used. "Intestinal union" is a term that is open to none of these objections and would seem to indicate the procedure.

In regard to the continuous suture, I have had a limited clinical experience in intestinal suturing, but a rather extensive experimental experience, and have found that this form of suture is by far the most satisfactory. I believe that the majority of operators who have done much experimental work will agree in this. This form of suture has many advantages not possessed by the interrupted. It is a physiologic principle that rest is essential for repair. It is with this idea that splints are used in fractures and wounded parts immobilized as much as possible. The action of a continuous intestinal suture is in the nature of a splint. In end-to-end union, for

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instance, where interrupted sutures are used, each distension of gas and every wave of peristalsis tends to stretch or relax the portion of intestine between any two interrupted stitches. When a continuous suture is used this strain is thrown, not on the wounded intestine, but on the thread. It is frequently taught, I believe, that all that is necessary to obtain complete union in intestinal suturing is to approximate serosa to serosa. This is certainly a false doctrine, for something else than mere approximation is necessary to obtain satisfactory union in every instance. This conclusion has been arrived at as the result of nine experiments on dogs. In six fine black silk was used and the dogs were killed after one, two, three, four, six and eight days. In three experiments No. 2 braided silk was employed and the dogs killed after four, six and eight days. Two loops of intestine were sutured, as in the preliminary steps of Abbe's intestinal anastomosis, the suture being continuous and running for about an inch and a half in the long axis of the gut. Another row parallel with the first and about one-third inch distant from it was inserted in the same manner. The specimens were removed after the number of days above indicated and sent to a competent eastern pathologist for examination. The condition of the serosa between these rows of sutures was that of perfect approximation, and on account of the continuous suture it would be impossible for this approximation to be disturbed. The pathologist reported that of the first six experiments, in four there had been failure of complete union of that area of intestine included between the rows of suture; in the other two, in which fine silk was used, the union was complete. Of the three experiments where No. 2 braided silk was employed, only one failed to unite completely. The pathologist also reported that there was markedly more inflammatory reaction around the coarser thread. As the conditions of approximation in these experiments were perfect, and as complete union was obtained in less than half of the number, it would seem that something else besides mere approximation is necessary for satisfactory union. Pressure is one of these things that is most desirable and is furnished by such appliances as the Murphy button. This pressure can be obtained by the continuous suture, but not by the interrupted.

DR. H. O. WALKER, Detroit—The methods by which the operation of intestinal resection is to be performed have been outlined by the gentlemen who have read papers and by the gentlemen who have already discussed them. The method given by the first gentleman would strike me as being one (possibly he can do it rapidly) that would take considerable time, while, as the gentleman just preceding said, it leaves some of the knots on the outside. I have had experience with pretty nearly every form of suture and mechanical appliance. I did one end-to-end anastomosis with the Murphy button in the latter part of 1902. I have used the Connell suture in six different

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cases; one where I removed 14½ inches of the colon, another 8 inches of the ileum, another the ileocecal junction, another 6 feet of the intestine, another at two different points in the descending colon. The first three cases were successful and the last three died, but I do not know that it could have been otherwise, because the condition of sepsis was such as to preclude recovery.

There is no mechanical device that has recently been brought before the profession that is of more value than the McGraw elastic ligature. I have had an experience in 17 cases with that ligature, and in all of the cases it was successful, so far as temporary relief was concerned. Of these 17 cases 122 jejunostomies were performed for malignant disease and 5 for gastroptosis. The use of the ligature as a mechanical appliance is simpler than anything else that we have. Of course, it is not applicable to an end-to-end anastomosis. It can be done quickly and produce no inconvenience. As has already been stated by the former speakers, no man should attempt to use this ligature unless he has practiced either on animals or on the dead intestines. In regard to the application of this ligature, you take a rubber darning needle, about 6 inches long, and be sure that the rubber in the ligature is in good condition, for in those ligatures which have been on hand for a long time the rubber is liable to break. For instance, we are doing a gastrojejunostomy. You take a bite on the stomach about 2½ inches. First, we make an approximation and run the suture of silk around the intestine and the stomach and then we introduce the ligature, draw it through the stomach and come back again on the intestine. After you have got your ligature in position and drawn it up, be sure you have it well on the stretch before you begin to tie.

Dr. J. B. Murphy, Chicago—The technic of surgical approximation is, I think, of lesser significance than the recognition of the pathologic condition of the intestines in, about and below the line of approximation. I believe that by any of the ordinary methods we will get a good and sufficient approximation if we will recognize the pathologic conditions of the intestines, whatever the position of the approximations, and the failures in intestinal approximation rest principally, I believe, in not recognizing that the intestinal wall is infiltrated, and that its action is impaired for a considerable distance above the position of the resection. My attention was called to this in some of the early operations with the button, where I found gangrene following the insertion of the button. No other legitimate outcome could have been expected; no other result could have been secured by any other method. So soon as we learn to remove a sufficient amount of the bowel at the proximal end to leave completely healthy, uninfiltrated intestinal wall, we will have less failures. That accounts, in my opinion, for the failures in many instances.

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Dr. Alex. Hugh Ferguson, Chicago—I would like to raise my voice in favor of the promotion of every man who is going to do intestinal surgery. We can get no good by looking on and seeing others do these operations. We have to do it ourselves, and the paper read by Dr. Campbell is, in my opinion, a very excellent one. I have seen him perform the operation. I have looked over the notes very carefully, and I can see the beauties of that operation. In the first place, you have fewer sutures than by any other method. That flap can be rolled back very quickly, and the other sutures on the outside are few and are only the so-called "tack sutures," because they do not go through into the mucous membrane; so that, although they are on the outside of the bowel, they can not do any harm.

The suture which has seemed to me to be the best and that which I have used the most is the one introduced by Dr. Connell. I have used it a large number of times. The last few years I have been using it almost exclusively when I could, but occasionally I would get a little stuck and could not very well use it, and I would fall back on my old friend, the Murphy button. I have used the Murphy button a large number of times, and it has stood me well in some places where a suture could not be applied, for instance, in removing a section from the lower portion of the cecum or the lower portion of the rectum, where you can not very well employ the suture, but you can put in the large size of the Murphy button. In doing the Bacon operation for stricture you can use the suture and the patient does perfectly well. It comes in very well in gastroenterostomy, and, in fact, there are so many applications for it that I would not pretend to mention them now. The McGraw elastic ligature I used in one case where I had done a gastroenterostomy. I had become a little conceited and thought that I would not get a vicious circle. I made the approximation a little high up, so that the gastric current could not help go down. In this case I was mistaken; it would not do that, and consequently I had to open the abdomen again and make an anastomosis between the two arms of the anastomosis. I did that with the McGraw elastic ligature very quickly and it served my purpose. For some little time afterward he had slight trouble with the circle of Willis until the anastomosis was complete.

I would also like to emphasize what has been said by Dr. Murphy, that failures take place more frequently owing to error on the part of the surgeon in selecting the part where the bowel should be removed than from any defect in the technic.

Dr. O. Beverly Campbell, St. Joseph Mo.—It seems to me that the most of the discussion has been on the McGraw elastic ligature and the older methods. In regard to the knots outside the lumen of the bowel, which question was raised by

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two gentlemen, it was well answered by Dr. Ferguson, and certainly the knot can do but little harm, and it would certainly be far-fetched criticism that would criticise a knot of that character outside the lumen of the bowel. Of course, some surgeons are getting so very technical that it is a question where they will stop. Now we would not have expected this method to have received more than a discussion, but it does seem to me that we should have discussed this method rather than the older methods, as we are looking for better things, and not for the older methods that we have tested and which we know are good. We want something a little bit better.

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THE TREATMENT OF VASCULAR TUMORS BY THE INJECTION OF WATER AT A HIGH TEMPERATURE.

WITH SUGGESTIONS AS TO ITS EMPLOYMENT IN TUBERCULAR ADENITIS, ABSCESS, FISTULOUS TRACTS, ETC.

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Angiomata or non-malignant vascular tumors, especially those of large size, as cirsoid aneurisms or cavernous nevi, are among the most difficult lesions with which the surgeon has to contend. In fact, a considerable number of these cases have heretofore been deemed inoperable, and have been abandoned to an ever-increasing deformity and discomfort and, in some instances, to death from hemorrhage, pressure or other cause.

While I do not claim that the method I am about to submit is infallible or will cure every case, or is without danger, I am convinced it is worthy of serious consideration.

These vascular neoplasms may be classified on an anatomic basis as arterial, capillary and venous. The arterial angioma, or cirsoid aneurism, is most infrequently observed. The venous variety (cavernous nevus) is next in order of infrequency, while the capillary form, or "mother's mark," is most common.

In 1900, attracted by the success which my colleague, Prof. R. H. M. Dawbarn of New York, had achieved in his operation for the starvation of inoperable tumors of the nasopharynx by dissection of all those branches of both external carotid arteries which are distributed to

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the regions involved, I began experiments to determine if this might not be accomplished by a simpler method, which would bring the operation within the scope of many practitioners who might hesitate to undertake such an extensive dissection in one of the so-called dangerous surgical regions. The idea in mind was to obliterate the terminal branches of the external carotid arteries by injecting into the lumen of the parent trunk below the points of origin of these branches, paraffin, alcohol, or some other substance which would cause occlusion of the vessels and render the denutrition of the tumor less difficult and more thorough.

The experiments were made on the arteries of dogs, and the substances employed were paraffin, alcohol and boiling water. Neither of the first two proved satisfactory, while the injections of water at the boiling point into the iliac of a dog caused immediate occlusion of the vessel and all of its branches. This result convinced me that with this agent the coagulation of the blood and albuminoids in vascular neoplasms was possible. The first operation was made in the following case, which had been abandoned as incurable:

Miss V. D., aged 20, consulted me in 1897 for a large cavernous nevus occupying the right lower jaw and chin and a portion of the neck immediately underneath the chin and jaw of the right side. (Fig. 1.) The tumor was congenital, had increased in size progressively with the development of the patient during her growing period, and had continued to enlarge after she had reached her full growth. Pressure of the mass had worn away the outer surface of the lower jaw, and an extensive network of enlarged veins could be seen beneath the mucous membrane of the buccal wall. The skin covering this mass of blood vessels was normal in color. She informed me that the late Dr. Hunter McGuire, Richmond, Va., had essayed to remove the tumor by operation, but had abandoned it on account of hemorrhage. I repeated this effort, proceeding very cautiously, but was convinced from the extensive bleeding which followed a very small incision that the patient would perish if I persisted in the effort. The wound was packed and firm compression applied, and as soon as her condition permitted she was allowed to return home.

On July 14, 1901, under ether narcosis, an area covering

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one-third of the tumor was injected with from two to three ounces of boiling water. To preclude as far as possible the danger of embolism, peripheral compression was applied. With the distension of the tumor the integument became very warm to the touch, and at one time there was sufficient heat to cause my assistant, who had two fingers inserted into the mouth, to remove his hand. The medium aspirating needle was carried through the mass to within one-half of an inch of the limit of the diseased area and the boiling water forced out of the syringe until the integument turned pale under the distension. Notwithstanding the great heat there was no necrosis of the mucous membrane or the overlying integument.

The operation lasted ten minutes, and there was no pain or elevation of body temperature at any time after the patient became conscious. The blood and albuminoids were evidently coagulated. Within two weeks the area injected had diminished at least one-half in size, when a second operation

Fig. 1.—The angioma before treatment.

Fig. 2.—After the first and second injections.

was performed. At this time the injections were made through the entire remaining portions of the mass with a result equally as gratifying as at the first procedure. At the end of the second week, when the patient left me, the tumor had diminished two-thirds its former size. A third injection of a small area which had escaped coagulation was one year later performed by Dr. Stuart McGuire, Richmond, Va., with success. The accompanying photographs show the gratifying results in this case. (Figs. 2 and 3.)

Case 2.—A second and more difficult case of this form of angioma is that of C. G., a well-developed child of 9 years, of Lowell, Mass. At birth there was a small "mother's mark" or blue spot, about as large as a quarter of a dollar, on the back just above the right shoulder blade, a little to the right of the median line. At the age of 2 years it began to grow perceptibly, and continued to enlarge in all directions, drifting chiefly downward and to the right. In her fifth year, when the tumor was about seven inches in length and half as wide,

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an effort was made to remove it by operation, but on account of hemorrhage it was abandoned. The wound was packed, became infected, and resulted in the cicatrices which are shown in the photograph. The neoplasm reappeared in all parts of the operative wound, and one and one-half years later a second attempt was made, and this was also abandoned.

When she came under my observation, on Feb. 27, 1902, there was a large venous angioma occupying the back from the edge of the trapezius muscle above the right shoulder blade, over the shoulder, reaching to the middle line between the two scapulæ, then down along the posterior border of the right scapula, extending as far as the twelfth rib and well forward to the right side. The whole mass was slightly crescentic in shape, its surface was from one to two and a half inches above the level of the body, and from the elevation of the right shoulder it was evident that the abnormally enlarged vessels had burrowed between the ribs and the scapula. To the touch it was soft and compressible, the venous channels remaining empty under pressure and refilling as soon as this was removed.

Under ether narcosis the boiling water injections were made as in the former operation, the needle being inserted in eleven different points through the neoplasm. Between five and six ounces of boiling water were thrown in. The child complained of no pain after consciousness was restored. Coagulation was evident, and within two days the area injected began to undergo diminution by granular metamorphosis. By October the entire growth had disappeared with the exception of the rounded mass, about three inches in diameter, and elevated about one and a half inches above the skin, shown in the center of the area in black in the accompanying illustration. (Fig. 4.) This was injected in October, 1902, which completed the cure.

In the first operation in this case a necrosis of the skin over an area of about one inch in diameter resulted from hyperdistension with too much boiling water at this particular point. After the child left my care and returned to her home in Massachusetts this became infected and some suppuration ensued, but it in no way interfered with her recovery and the cure of this large and otherwise incurable growth.

The method has been successfully employed in arterial angioma, or cirsoid aneurism, as shown by the following case:

CASE 3.—Miss S. C., aged 27, came under my observation January, 1902. In 1885 the patient noticed a small pulsating

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tumor in a branch of the temporal artery situated directly over the ear. Compression on the artery in front of the ear by means of a cork held in place by bandage tied around the head was tried for a prolonged period. While it controlled all pulsation as long as the pressure was applied, it did not obliterate the artery or cure the angioma.

In 1886 Dr. J. M. Taylor tied the temporal artery in front of the ear, but without benefit, for after this operation the tumor increased in size. In 1887 Prof. T. G. Richardson, New Orleans, attempted to strangulate the mass subcutaneously, but without success. At a later period he introduced several large pins through the base of the tumor and surrounded it with a strong ligature. By repeated tightening of the ligature he succeeding in cutting off by strangulation a considerable section, to the base of which caustic potash was applied. The tumor, however, continued to grow, and although this attempt was repeated a year or two later by Dr. Rich-

Fig. 3.—After the third injection.

ardson, it failed again, and any further operation was abandoned.

In January, 1902, there was a large pulsating mass covering about one-half of the left side of the scalp, which measured approximately five by six inches and was elevated above the level of the normal scalp from one-half an inch to an inch. On the surface there were several large cicatrices which had resulted from the efforts of strangulation, and along the border of these scars were three or four small patches of papillomata. Leading into this tumor were five arteries, which could be seen distinctly pulsating with increasing motion as they approached their entrance to the mass. Two of these came from the left temporal, one from the right temporal and one from each occipital. The center of the angioma corresponded to the point where pulsation was first noticed. It had grown so rapidly within the year that the patient was compelled to seek relief by operation, which was done on Jan. 4, 1902, under ether narcosis, the scalp having previously been shaved and thoroughly disinfected.

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The needle was entered along the course of the arteries leading into the tumor, beginning about two inches from the mass, a quantity of boiling water sufficient to coagulate these vessels being employed. It was then introduced through the tumor from side to side, injecting about a dram, withdrawing the needle for one-half of an inch and then repeating this procedure until the entire mass had ceased to pulsate. The quantity of boiling water so used was between five and six ounces. Temperature on the surface was noticed by touch, and when the heat became very perceptible to the hand and the skin began to bleach the injections in that particular area were discontinued. The warty growths noticed on the surface of the scalp were touched with the Paquelin cautery. No reaction followed the operation. The patient complained of

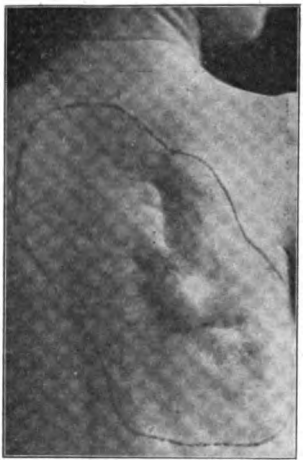

Fig. 4.—After the second injection.

no pain, but there was a very considerable edema of the scalp, and this, beginning on the left (the side of operation), closed the left eye and spread over the face, closing the right eye within forty-eight hours. The swelling spread as far down as the neck and was so great that had I cause to repeat a similar operation I would use only about one-half the quantity of water, and would then repeat the operation after the interval of about a week.

Dr. G. C. Chandler of Shreveport, La., a brother of the patient, writes me under date of Nov. 12, 1902, that "no pulsation is present, and there is slight depression where the tumor was, owing to attrition of the skull by the long pressure of the pulsating mass. The scalp is no thicker than that covering the normal skull, and while a slight eczema

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persists where the tumor was situated, the hair seems to be more plentiful than before the operation."

I have employed this method successfully and without accident in a number of cases of capillary angioma, but, on account of their superficial character, they being within the substance of the integument, some cicatrization is apt to result unless very great care is taken. The weak tissues of the new growth do not offer the resistance of the normal skin which overlies the venous or arterial angiomata, and may break down under the hot water. In all of my cases the scarring has been very slight, and I think the method is well worthy of thorough trial in these cases. As they occur chiefly in children and are situated on the face, it is important to have the patient very firmly held while the injections are being made without nareosis. The legs, arms, body and head should be kept immovable, while the face should be covered by a mat in which an aperture is cut sufficient to expose the area to be injected. I take the additional precaution to have an assistant hold a sponge saturated with cold water immediately over the needle in order to prevent scalding the cuticle should the apparatus leak. The small hypodermic needle is used, and this should be thrust through the sound skin, about one-eighth of an inch from the edge of the angioma, pushed beneath the neoplasm, care being taken not to let the point come through the surface. From five to fifteen minims of water may be injected in one spot, changing the needle here and there to suit the size of the mass. When the injections are made directly into the enlarged capillaries, necrosis almost always occurs, but if the water is forced well beneath the surface, the deeper parent vessels will be coagulated, causing the nevus to disappear by gradual denutrition (granular metamorphosis). It is a wise precaution to cover the area injected at once with aseptic collodion to prevent infection. This operation may be repeated from time to time until a cure is effected.

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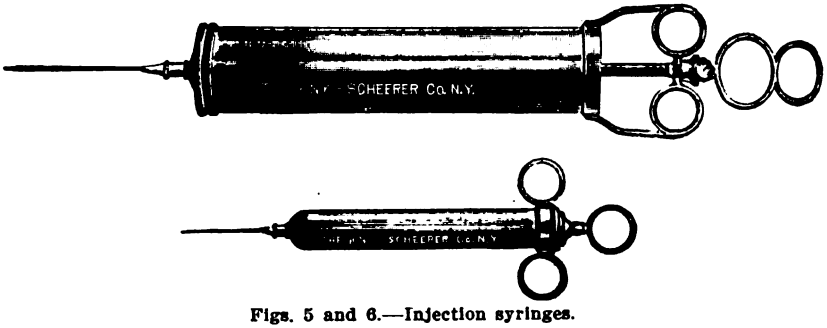
Water at a high temperature will without doubt become more frequently employed in the treatment of various minor surgical diseases. It has already been employed by Dr. Lucien Lofton of Virginia in the treatment of hemorrhoids, and, while I do not approve of the treatment of hemorrhoidal tumors by injection, always having in mind the danger of hepatic or other embolism, if, in the judgment of the surgeon, this operation is deemed advisable, hot water is the safest agent.

It has been employed successfully in the treatment of fistula about the rectum. When there is, as most frequently exists, only an external aperture with no communication with the cavity of the rectum, boiling water



Figs. 5 and 6.—Injection syringes.

injected so as to be brought in contact with the entire surface of the fistula and abscess should destroy all septic organisms and effect a cure.

The late Dr. Ackard,[1] Springtown, Texas, reported to me a number of cases in which he had cured fistulæ by this method. It is my intention to give this method a thorough trial in the treatment of tubercular adenitis, preferably before pyogenesis, and I shall not hesitate to

1. Dr. Ackard accidentally discovered the efficacy of hot water in the treatment of fistulæ. In irrigating a fistula, by a mistake of his office boy, the syringe was filled with water almost at the boiling point, with which he flushed the fistulous tract. The patient suffered great pain from the application, but the fistula was cured. He repeated this in a series of cases under chloroform narcosis with success.

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employ it in gonorrheal bubo. in ranula,[2] in small cysts, and abscesses and lipomata.

I have used the method in one case of very large inoperable sarcoma of the shoulder and scapula, using more than a pint of boiling water. The operation was followed by extensive sloughing, with improvement of the patient's general condition, but without curative effect, and, while he is still living, I do not think he can long survive his malignant disease. I have had numerous inquiries in regard to the application of this method to uterine fibromata, but my reply has invariably been that hysterectomy was the better procedure.

DISCUSSION.

DR. WILLIAM J. MAYO, Rochester, Minn.—While I was in New York last November I visited Dr. Wyeth's clinic and had the pleasure of seeing two of the cases reported here to-day. One of them was an enormous angioma, which I do not believe any of us would have felt like taking out by the knife. I was very much impressed with the result and asked Dr. Wyeth to send me an apparatus. In a very short time we had a large venous angioma of the cheek of a young man. To have removed it with the knife would at best have meant a very bloody operation and probably sacrifice of the seventh nerve. With this apparatus one and one-half ounces of boiling water were injected into the tumor, and it promptly coagulated, and in two or three weeks two-thirds of it had disappeared. I have since heard that the growth is almost entirely gone. None of us desire to employ excision in these cases when we can help it, and I was struck with the ease with which this method can be used and the almost certain results. I believe it is one of the advances in the treatment of tumors of the blood vessels.

DR. JOHN P. LORD, Omaha—Modern surgery some years ago attempted to accomplish almost everything, and, therefore, some of the old injection methods of the masters were abandoned, and probably they have not been practiced for several years until recently. Last year I had a case to treat very similar to that described by Dr. Mayo. This nevus so involved all the structures of the cheek that its removal would have necessitated the sacrifice of the mucous membrane of the mouth, so that to remove it by surgical measures would have been absolutely out of the question. The use of electrolysis and the Paquelin cautery seemed to afford no adequate relief.

2. I have recently employed this method in a very large ranula with entire success.

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I therefore determined to treat by tincture of iodin injections. In looking up this subject, I found that most of the accidents reported by the older surgeons were due to embolism. Pilchner of Brooklyn observed that in the cases in which accidents had occurred by this method no precaution had been taken against the formation of embolism. I, therefore, took the precaution to cut off the circulation from the outgoing vessels by finger pressure, and the result was all that could be desired. It was very simple in its application. The results were very rapid. In the course of a few treatments, I had accomplished more than I had by the numerous other methods employed. About this time this method of Dr. Wyeth's was published. I have not used it, but I believe that it has a very large use, and I believe also, that we can use safely, in proper locations, the injection of other coagulating agents.

DR. RICHARD H. GIBBONS, Scranton, Pa.—I have seen Dr. Wyeth perform this operation in several instances, and I have seen this remarkable case of monstrous angioma, which he removed entirely by this method, and it makes me feel that the procedure is one of the very greatest value to the profession. It would be very painful to remove by the knife most of these monstrous angiomata, and in many cases it would be absolutely impossible, but they can be safely removed by this method. I believe that this method would be of value in fibroid and other tumors of the uterus. An opening could be made through the vagina; we could ascertain the proper place, make the puncture and then inject the hot water. Later an incision could be made higher up and the tumor exposed and injection made in this region in the same manner, which would doubtless render the patient more comfortable than any other application or treatment.

DR. JOHN A. WYETH, New York—In regard to the employment of any apparatus for the registration of heat, I think it scarcely practicable. The operator should judge by the sense of touch and by the bleaching of the skin as to the proper degree of heat and tension. In choosing between the hot-water injections and excision by the knife one must be guided by the conditions which are present. Where the angioma is small and the skin deeply discolored, if excision can be practiced so as to remove the deformity and leave only a linear cicatrix, this operation would be preferable. But where mucocutaneous margins are involved, injections should be carefully and thoroughly tried.

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FURTHER EXPERIENCE WITH THE VERTICAL OVERLAPPING OPERATION FOR THE RADICAL CURE OF UMBILICAL HERNIA.

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The results of operations for the radical cure of umbilical herniæ in adults have, heretofore, not been encouraging. These patients are usually obese, with attenuated abdominal muscles, and the thin, rigid character of the ring does not offer mechanical conditions advantageous to lasting union.

The principles of closure have been the same as after an ordinary abdominal section, the object being to split the fascia at the ring margins laterally, until the recti muscles are reached, and then, by a series of buried sutures, to reconstruct the abdominal wall in layers. The defect in this method is the natural separation of the recti muscles at the level of the umbilicus. Below this point the muscular structures are practically in contact, but above there is from one-fourth to three-fourths of an inch separation. To bring the recti together in this locality amounts to a muscle transplantation. In a small hernia this muscular approximation is not difficult, and is the operation of choice, but in the larger openings an inch or more in diameter, it is impracticable, and, so far as I have been able to judge, the attenuated muscles, when secured, are not of great value as retentive agents in this variety of hernia. In very corpulent subjects the muscular separa-

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tion is greater. If such a patient, lying on the back, be directed to rise, bringing into play the recti muscles, the lateral deviation at the level of the umbilicus is easily shown, and in the majority of cases demonstrates the impossibility of bringing them firmly into median apposition. The strain in these cases is from above downward rather than laterally. This is well shown by the pendulous abdomen commonly found in very adipose people, in many cases covering the pubes and often the region of the upper thighs. On assuming the recumbent posture the stretched tissues allow of great mobility and one can often grasp the abdominal wall and overlap a number of inches without difficulty. The fibrous margins of the ring in umbilical hernia usually lie entirely above the junction of the urachus and the remains of the hypogastric arteries. These latter structures, as they deviate from the middle line below, often allow of the formation of considerable pouches between them and the urachus, showing their weight-bearing function.

The causation of acquired umbilical hernia can be said to depend on downward traction of the abdominal walls and their contents brought to bear on a fixed point at the umbilicus, causing separation, and before this takes place there is an increased vertical lengthening of the abdominal wall and also, to a less extent, in a lateral direction.

In a paper[1] read before the American Academy of Railway Surgeons, Oct. 4, 1898, I called attention to the impracticability of covering in the defect, left by excision of the larger umbilical hernia, with muscle, and advocated the overlapping of the aponeurotic structures which were already at hand, securing a wide area of adhesions in place of edge-to-edge union. This method we had then employed in five cases; in three the overlapping was from side to side, and in two from above downward. Extensive lateral incisions to find sufficient muscle to make the routine operation described by surgical writers

1. Annals of Surgery, January, 1899.

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compelled us, as a matter of necessity, to overlap from above downward in these two cases and, to our satisfaction, we found the parts came together with less tension than when drawn laterally, and time proved that the strength of union was as lasting.

The first of these overlapping operations was done in 1895. We have now made this operation 35 times, overlapping from side to side 10 times, and 25 times from above downward. There were no deaths. We have found the operation so much easier from above downward that we now employ it exclusively. We have recently had the majority of these cases examined and the permanency of cure was most gratifying; in only one case had there been a relapse, and in this one there was merely a boat-shaped stretching. The operation had been done from side to side, and the patient was much relieved from her former condition. So far as we could find out, there were no failures when the vertical overlapping had been properly accomplished. In a paper[2] on this subject read before the American Surgical Association, May, 1901, I again called attention to this method. Further experience with the operation, as well as good results in the hands of other members of the profession, has more than ever convinced me of its value. Writers on this subject deplore the poor results of operation for this variety of hernia and even the latest compilations speak most disparagingly as to the permanency of cure by any method, and this was previously our experience. To-day the expectation of cure approaches that of inguinal hernia. The operation is easily and quickly performed. The steps are as follows:

1. Transverse elliptical incisions are made surrounding the umbilicus and hernia; this is deepened to the base of the hernial protrusion.

2. The surfaces of the aponeurotic structures are carefully cleared two and a half to three inches in all directions from the neck of the sac.

2. Annals of Surgery, August, 1901.

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3. The fibrous and peritoneal coverings of the hernia are divided in a circular manner at the neck, exposing its contents. If intestinal viscera are present, the adhesions are separated and restitution made. The contained omentum is ligated and removed with the entire sac of the hernia and without tedious dissection of the adherent portion of omenta.

4. An incision is made through the aponeurotic and peritoneal structures of the ring extending one inch or less transversely to each side, and the peritoneum is separated from the under surface of the upper of the two flaps thus formed.

5. Beginning from two to two and one-half inches above the margin of the upper flap, three to four mattress sutures of silk or other permanent material are introduced, the loop firmly grasping the upper margin of the lower flap; sufficient traction is made on these sutures to enable peritoneal approximation with running suture of catgut. The mattress sutures are then drawn into position, sliding the entire lower flap into the pocket previously formed between the aponeurosis and the peritoneum above.

6. The free margin of the upper flap is fixed by catgut sutures to the surface of the aponeurosis below, and the superficial incision closed in the usual manner. In the larger herniæ the incision through the fibrous coverings of the sac may be made somewhat above the base, thereby increasing the amount of tissue to be used in the overlapping process.

In very large protrusions in which part of the hernial contents is irreducible the patient should be kept in bed on a reduced diet and directed to manipulate the hernia, with the intention of replacing as much as possible. The irreducible portion must not be forced into the abdominal cavity after losing the "right of habitation." If of omentum only, it is readily disposed of by excision; if intestine, enough omentum previously contained in the peritoneal cavity should be removed to

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allow of reduction of the bowel without pressure. The patients should be kept in bed three to four weeks after operation and, after getting about, should not apply a truss, although most of these patients prefer to wear an abdominal supporter for a year. Piccoli[3] reports a case successfully operated on in August, 1899, after the lateral plan, and refers to a case reported by Bonomo, operated on Dec. 9, 1899, with a favorable result. J. A. Blake[4] reports several cases operated on by the lateral method during the year 1900, and refers to an article by Sapiejko,[5] in which a lateral operation is described.

The writer had described and operated by the lateral overlapping plan several years before the cases reported by these authors and the lateral operation is a good operation, but it is not as good as the vertical method, in which the retaining structures are given a bearing point above the site of the umbilicus and intra-abdominal pressure thus acts to prevent separation instead of aiding it.

DISCUSSION.

DR. A. J. OCHSNER, Chicago—The fact that with but a few exceptions every text-book on surgery, and every book dealing with the question of hernia, claims for the radical cure of umbilical hernia: First, a large mortality; and second, a large proportion of recurrences, makes this paper of especial value to this Association.

The writers of these works have no appreciation whatever of the proper treatment of umbilical hernia. One of the most distinguished authors on the subject of herniotomy told me personally only a few months ago that he operated on these cases only when he was absolutely compelled to, simply because he did not know how to operate on them. As a matter of fact the reason there is a high mortality in these cases is because of the extreme and unnecessary traumatism occasioned by the ordinary operation. The ordinary operation contains at least ten times as much traumatism as is necessary. The operation usually described in text-books contemplates the establishment of conditions very similar to those which were present before the umbilical hernia was produced. The fact that those conditions were unfavorable for a permanent cure

3. Centralblatt fur klinische, Chirurgie, Jan. 13, 1900.
4. Medical Ass'n of Greater New York, Jan. 14, 1901.
5. Rev. de Chir., 1900, No. 2, p. 240.

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is shown by the fact that the umbilical hernia occurred. Statistics show that umbilical hernia in children heals spontaneously in nearly 100 per cent. of all cases, simply because it is impossible to keep a circular opening in any part of the body open, unless it is lined with a serous or an epithelial lining. So long as the opening is kept circular it will heal spontaneously. We find in all of these cases in the adult that there is a dragging of the abdominal wall transversely, causing the opening to assume an elliptical form. Then we find that the preperitoneal fat is forced up into this opening, the consequence being that the hernia occurs. To relieve this condition, we know that we can establish a condition very similar to the linea alba. We have the aponeuroses of the external oblique, the internal oblique and the transversalis muscles; we can make use of these, but we should not do so in such a manner as will prevent their drawing from side to side. This can be accomplished by the operation described by Dr. Mayo. In this manner the greater the tension on the abdominal wall the more firmly the hernial opening becomes closed. That is the reason he does not get recurrences. If the patient vomits, the more he vomits the tighter the wound is closed. I had the good fortune of learning this trick from Dr. Mayo several years ago. I have operated nearly as many times as he has, but I always closed the wound from above downward. In one-third of his cases he made the same mistake that Blake and the other gentlemen made who have described similar operations, but who overlapped the edges from side to side instead of from above downward.

The great advantage in this operation does not only come from the fact that the strong fascial layers are doubled but also from the fact that the deformity which always exists in these cases, namely, the shortening of the transverse circumference at the level of the umbilicus and the lengthening of the distance between the sternum and the pubis, is utilized to advantage.

Dr. J. B. Murphy, Chicago—It is a particular pleasure for me to discuss a paper on umbilical hernia, because I have had some misfortunes. I was very much surprised at the close of my clinic one day to have a visiting physician ask me if a case of umbilical hernia ever got well. That was an actual occurrence. He had just visited several other celebrated clinics and he said that all the cases he had seen operated on there died. It frightened me, and that very day the patient whom I had operated on died. That caused me to make some investigations and to ask some questions and it led me to visit Dr. Mayo and observe him do this work. My particular patient died from one of the causes that is cured by just this operation, and I believe that many of the other deaths have resulted from just this same cause, because in

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looking up the literature you will find that most of them died shortly after the operation. My patient died of pulmonary edema. In doing the lateral operation, the tension put on the suture incapacitates the patient for diaphragmatic breathing and the patient has an edema beginning shortly after the operation, and if the irritation is sufficient, in one, two or three hours after the patient has recovered from the anesthetic, you will see him panting for breath. It was my extreme pleasure, after doing the first operation by this method, to see that the patient was vomiting without even the slightest distress at the seat of the wound, and the reason for that is the excellent mechanical application, the one applied on the other, giving such perfect support that there is no tension on an edge-to-edge suture. I feel that the question of umbilical hernia is solved primarily and finally by this very simple, complete and perfect operation.

DR. WM. H. WATHEN, Louisville, Ky.—If we perform the operation for umbilical hernia, as outlined by Dr. Mayo, we have no bad results following the operation, and then consider the previous methods in vogue for this procedure and the high mortality following them, we will come to the conclusion that there is no operation which has more simplicity about it, or which may be performed with less mortality and with better results. Since I saw the report of Dr. Mayo's first operation, I have been performing it, and find it practically universally successful. About a year and a half ago, a lady consulted me, who was so large and fat over the abdomen that certainly no surgeon would have undertaken the operation after the old method, the hernia being very large, with many adhesions. She was operated on by the transverse overlapping method, taking away a very large piece of fat, and recovered without pus or temperature. She now has an abdomen changed in shape, and is perfectly well in every particular. I have had no trouble in these cases during the operation or subsequent thereto.

If I understood Dr. Oschner correctly, he said that the great success in these operations was due to the fact that it shortened, or contracted the transverse diameter, and elongated the abdomen longitudinally. Well that is what may occur in the old vertical method, but not in the overlapping transverse method. You shorten the abdomen vertically. The pressure transversely cannot pull the surfaces apart, and the patient continues to get well.

DR. WILLIAM H. MAGIE, Duluth—I wish to endorse the operation of Dr. Mayo by reporting two cases of umbilical hernia that I have operated on during the past year. They were both very fat women, the hernias were of long standing, and the results so far have been very satisfactory. I have used the same method in operation for cures of ventral

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hernia resulting from surgical operations in the abdominal cavity.

Dr. Alex. H. Ferguson, Chicago—A lateral operation for umbilical hernia is indicated in certain cases, and in others I would commend the operation worked out by Dr. Mayo. In either instance the procedure is a plastic one in which the surgeon makes the best use of the material at hand to most securely prevent a return of the hernia. When the opening is not very large, the recti muscles in good condition, the lateral operation gives excellent results, remembering that the muscles must be liberated and sutured in mid-line over the coapted peritoneum, and transversalis fascia. Any redundancy of the pendulous fat in the abdominal wall may be removed at the same time and greatly to the comfort of the patient. This I have done several times.

When, however, the opening is large it can be more easily closed by overlapping the structures from above downward and thereby obtain a very strong abdominal wall. But let me suggest an additional step which furnishes more strength to the umbilical region. That is to slit open the sheaths of the recti and bring them nearer together over the overlapped fibrous structures. This will leave these muscles in a position to protect by their contraction a weak place during sudden increased intra-abdominal pressure.

While I agree with Dr. Murphy that it is not a good thing to constrict the abdomen, still I should be inclined to attribute the cause of death in his case as due to something else.

Dr. William J. Mayo, Rochester, Minn.—In answer to a question I will say that we have removed the fat in two cases. I feel somewhat overcome by the remarks of Drs. Ochsner and Murphy, and I think we must all take them as a joke. Dr. Ferguson has insisted on saying that this is the Mayo operation. My own feeling is that all this stuff about priority is bosh. I have no doubt that this operation was done by Hippocrates; he was a very sensible old fellow and quite likely, as they get in deeper in the Egyptian ruins, they will find that this operation was performed by the inhabitants several thousand years ago.

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EVOLUTION OF THE MAMMALIAN STRAIGHT GUT.

WITH SPECIAL REFERENCE TO PERITONEAL CHANGES INCIDENT TO ROTATION.

W. T. ECKLEY, M.D.
CHICAGO.

As is generally conceded, the adult peritoneum of man, while a macroscopic structure of liberal proportions, is, nevertheless, complex beyond the ken of the ordinary student, without embryologic study. To such an extent have certain organs as spleen, liver, stomach, pancreas and colon migrated from their primitive location in the posterior mid-line of the body cavity, and contracted such intimate and deceptive physiologic adhesions, that even embryologic speculation as to the *rationale* of their migration was slow of general acceptance by the profession. If, now, to these numerous physiologic departures there be superadded pathologic departures incident to inflammatory processes, some conception of the difficulty confronting the student in his dissecting-room study may be imagined.

Within recent years our standard text-books on anatomy were monumental in their respective chapters on the peritoneum, to the most flagrant violation of perspicuity. There is no longer doubt that in the study of the abdominal organs and their investing peritoneum, two methods must be pursued: 1. The practical method by which each organ, with its corresponding peritoneal investment, is to be identified and studied *in situ*. 2. The embryologic method, by which the products of the primi-

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tive straight gut, Wolffian bodies, Müllerian ducts, and indifferent sexual gland are studied, in their successive developmental stages, from the simple to the complex. According to Huntington, the peritoneum of certain lower animals should be studied along with the human peritoneum, because in them the permanent adult arrangement corresponds to one of the early embryonal human stages. Huntington says:

> It is doubtful if the detailed developmental stages in man can ever be clearly comprehended unless the student will for himself examine the conditions, and perform the manipulations (of rotation) in one of the lower animals. The necessity of keeping the three dimensions of space in mind, and the fact that certain structures during and after rotation cover and obscure each other, make diagrams and drawings unsatisfactory unless the actual examination of the object itself is combined with their study. The cat answers every purpose of this study admirably.

It is believed that the mechanical device here presented will be of some advantage to the teacher in presenting the difficult subject of the anatomy of the peritoneum to large classes of students. It has the further advantage, by virtue of its strength and stability, of being available for the use of students, who can readily learn its proper manipulation. The device, constructed principally of rubber dam and inflatable bags and tubes, simply reflects the embryologic illustrations in our textbooks. It is not intended to supplant the practical study of the peritoneum of man or the lower animals. We believe it shows with tolerable accuracy the mechanical principles involved in the following points:

1. The primitive straight gut attached (a) to the posterior abdominal wall by a dorsal mesentery; (b) to the anterior wall as low as the umbilicus by a ventral mesentery; (c) to the umbilical region by the intra-embryonal part of the yolk stalk.

2. A dilation of the gut tube, differentiating the primitive tube into stomach and intestine, and its investing peritoneum into mesogaster (ventral and dorsal) and mesentery.

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3. A drawing out of an U-loop of gut from the dorsal wall, increasing the length of the mesentery, and presenting an upper and a lower limb separated at the neck of the loop by the superior mesenteric vessels.

4. Evagination of liver and gall ducts from the ventral wall of the duodenum into the anterior mesogaster, showing location of the primitive gastrohepatic omentum and the derivation of the hepatic peritoneum from the anterior mesogaster.

5. Evagination of pancreas and its duct from the dorsal wall of the duodenum into the posterior mesogaster, showing the primitive peritoneal investment of this organ.

6. Location of the spleen in the posterior mesogaster, in close proximity to the pancreas, showing the gastrosplenic omentum and the phrenicosplenic ligament derived from the posterior mesogaster.

7. The broad ligament of the liver, the hepatic peritoneum, the gastrohepatic or lesser omentum, the gastric peritoneum, the mesoduodenum, the splenic and pancreatic mesenteries, and the gastrosplenic omentum—all of which are derived from, and are specialized parts of the primitive mesogaster.

8. Rotation of the mesogaster whereby liver, stomach and spleen begin to assume their adult relations, and dimly foreshadow the beginning of the lesser cavity of the peritoneum.

9. Evagination of posterior mesogaster to the left, showing the formation of (a) the greater omentum; (b) the foramen of Winslow; (c) implantation of the posterior mesogaster and pancreas on posterior abdominal wall, to the left of the mid-line of the body.

10. Rotation of the U-loop of the intestine from left to right about the long axis of the superior mesenteric vessels, showing the transverse duodenum passing beneath these vessels, and taking up its adult position.

11. Differentiation of the gut caudad to the attachment of the yolk-stalk into a large and small intestine.

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The following summary, founded largely on Heissler, includes the salient points in the evolution of the alimentary canal and its accessory organs, and points out (a) the condition of the structures during the period of primary parietal peritoneum before rotation; (b) the migration of organs, consequent on rotation, when they acquired their adult position and relations; (c) the structural changes in certain localities, in both visceral and parietal peritoneum, incident to adhesion between peritoneal surfaces; (d) the mechanism of rotation, whereby liver, stomach, spleen, pancreas, duodenum and intestines departed to greater or less degree from their primitive location in the mid-posterior line of the abdomen. I also append observation on 200 cadavers with reference to rotation.

1. The abdominal part of the alimentary canal, in the second week of embryonal life, consisted of a gut tract separated in part only from the yolk-sac.

2. In the third week, the gut tract assumes somewhat the form of a straight tube, presenting, near the head-end, caudad to the future stomach, the beginning of an evagination, the future liver.

3. In the fourth week the straight gut dilates cephalad, initiating the future stomach. The lumen of the bile passages is completed, and the liver-diverticulum divides, thus foreshadowing the future major lobes of the liver; the pancreas is evaginated from the duodenum, growing subsequently into the mesoduodenum and posterior mesogastrium.

4. The original straight gut in the fifth week becomes somewhat convoluted, and foreshadows the first tangible evidence of its future complexity in the U-loop, and a disposition to differentiate into large and small intestine. The loop consists of (a) an apex attached by the vitelline duct to the yolk-sac; (b) of a descending limb, which subsequently develops the major part of the small intestine caudad the duodenum; (c) of an ascending limb from which the future cecum, ascending and trans-

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verse cola, and distal end of the ileum are derived. The loop, by traction exerted through the yolk-sac, now projects its developing coils (up to the tenth week) through the open abdominal walls into the hollow of the umbilical cord, thus forming, according to Huntington, the so-called umbilical embryonal intestinal hernia. It should be noted that growth proceeds from the apex of the loop; that growth of the descending limb of the loop is rapid, while that of the ascending limb is slow.

5. In the sixth week the duodenum, enclosed in the mesoduodenum, and presenting its well-advanced hepatic and pancreatic evaginations, is fully differentiated from the stomach, and develops its primary duodenal loop. At this period the cecum is formed by buddation and the rectum is developing.

6. In the seventh week the transverse and descending cola are indicated, and, by a process of unequal growth, the cephalic end of the colon differentiates into cecum proper and appendix vermiformis.

7. In the eighth week the gall bladder is formed, and the anlage of the spleen is first observed.

8. In the tenth week the loop of small intestine, which up to this time was encouraged to protrude into the hollow of the umbilical cord, begins to enter the abdominal cavity, a circumstance due to the closing in of the somatopleure on the future umbilical opening.

9. In the twelfth week the histologic characters of the adult peritoneum become established and rotation occurs, a process by which organs, thus far in the mid-line of the body cavity, begin to assume their adult relations.

At this period, the third month of fetal life, immediately preceding rotation, the parts of the alimentary canal with their investing peritoneum and blood vessels, are about as represented in the model. It may be in order now to review the salient features presented before rotation, in order that the post-rotatory locations and

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relations of organs, with consequent loss of peritoneum in certain places, may be better appreciated.

The stomach appears in the mid-line as a dilatation of the initial end of the intestine between two layers of peritoneum known as mesogastrium. As the stomach enlarges it displaces these two layers, and gastric peritoneum is the name given to the displaced membrane.

The double layer of peritoneum, which, enclosing the stomach, proceeds, ventrad to the anterior and dorsad to the posterior abdominal wall, under the name of ventral and dorsal mesogastrium respectively.

The liver, developed as an evagination from the ventral surface of the duodenum, acquires its artery from the gastroduodenal which originally traversed the space of the posterior mesogaster and entered the anterior mesogaster. As the liver grows, it displaces peritoneum (anterior mesogaster) and the displaced membrane is called hepatic peritoneum. The liver is now seen to occupy a place in the mid-line of the body, anterior to the stomach, between two layers of ventral mesogaster.

The two layers of peritoneum bridging the space between the stomach and liver, is a part of the anterior mesogaster called the gastrohepatic (and containing the root structure of the liver) or lesser omentum. Likewise, the two layers of anterior mesogaster extending from the liver to the diaphragm constitute the falciform ligament of the liver.

Pancreas.—The pancreas arises as an evagination from the duodenum. It grows into the mesoduodenum and into the adjacent segment of the posterior mesogaster.

The spleen develops from mesodermic tissue near the cephalic end of the stomach, between two layers of the posterior mesogaster, and subsequently takes up its adult location as a result of rotation.

The mesogaster at this period consists of two layers of peritoneum, enclosing the stomach, liver, spleen and pancreas. Its four parts unoccupied by these organs are

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the falciform ligament, the lesser omentum, the part attached to the posterior wall of the abdomen, and the great omentum.

The primitive duodenum extends from the stomach to the neck of the U-loop of intestine. It obtains at an early period its nourishment from the primitive gastro-duodenal artery, from which the hepatic artery is ultimately derived. It has a well-marked dorsal mesentery, the mesoduodenum, consisting of two peritoneal layers.

The U-loop, from which the small intestine caudad of the duodenum and the future ascending and transverse cola are derived, is between two layers of primitive dorsal mesentery, which finally differentiates into the mesentery proper and the mesocola of the ascending and transverse cola.

It will be observed that at this period, before rotation, the walls are covered by primary parietal peritoneum, and that the alimentary canal, liver, stomach and pancreas are invested by primary visceral peritoneum.

As a sequence of rotation, a transposition of organs occurs by which the liver and spleen appear laterad to the stomach. The stomach itself assumes now a more horizontal position in place of its vertical embryonal position, and consequently retaining distorted relations to liver and spleen, through their respective omenta.

The posterior mesogaster evaginates to the left, forming great omentum, and its cavity the lesser cavity of the peritoneum. As Huntington puts it:

> **The changes which are to be observed in the later stages, depend principally on a peculiar feature characteristic of the development of the dorsal mesogastrium. This feature consists in the extreme redundancy of the membrane, which grows out of proportion to the requirements of its visceral connections, and to a certain extent becomes independent of the direct mechanical purpose of carrying blood vessels to the viscera.**

The mesoduodenum immediately succeeding the stomach has right and left surfaces which embrace the head of the pancreas. It falls to the right, presenting thereafter ventral and dorsal surfaces with the head of the

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pancreas resting on the vertebral column, vena cava, and right kidney.

Note the relation of the duodenum, superior mesenteric vessels and colon at the neck of the U-loop. Upon rotation, the duodenum is ventrad, the colon dorsad, with the vessels between. After rotation, the relation of the duodenum and colon are reversed.

Mechanism of Rotation: (a) The large intestine passes ventrad and dextrad across the jejunoileal coils toward the cephalic end of the abdominal cavity, and lies transversely along the greater curvature of the stomach. (b) The cecum turns to the right against the caudal surface of liver and ventrad of duodenum, and reaches the ventral surface of the right kidney. The colon is crowded cephalad; the small intestine to left and downward. The small intestine rotates about the axis of the superior mesenteric vessels, bringing the transverse duodenum beneath these latter, and in contact with the vena cava and aorta.

Peritoneal losses, the result of adhesion, are sustained in the following localities: (a) The ascending and descending cola lose their visceral peritoneum at contact point with the walls, while their respective mesocola become secondary peritoneum for the posterior abdominal walls in these regions. (b) The second stage of the duodenum loses its visceral peritoneum dorsad, where, as a result of rotation, it continges the abdominal wall and right kidney; also where it lies dorsad to the hepatic flexure of the colon. (c) The transverse duodenum suffers peritoneally where it rests beneath the superior mesenteric vessels, and on the vena cava, aorta and vertebral column. (d) The great omentum suffers concrescence of peritoneum at the contact point of the left kidney, pancreas, transverse colon and mesocolon, and on the posterior abdominal wall in the neighborhood of the diaphragm.

The following observations on peritoneum and alimentary canal were made with special reference to devel-

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opmental sequences of rotation, on 200 bodies, and appear as a dissecting-room record:

1. Non-concrescence of great omentum. In ten instances adhesion between anterior and posterior layers of great omentum had not occurred.

2. Foramen of Winslow obliterated. In twenty-five instances, obliteration of the foramen of Winslow, presumably from inflammatory causes, had taken place. In seven of these twenty-five cases there were evidences of extensive inflammation of the right pleura. This would seem to be a practical illustration of the possibility of a septic fluid in the right pleural cavity gaining access to the peritoneum through the hiatus diaphragmaticus.

3. Meckel's diverticulum. In fourteen instances Meckel's diverticulum was present. The longest was five inches, the shortest one inch in length; the smallest was about the size of an ordinary sewing thread, and patulous.

4. Ascending mesocolon. In twenty-two instances there was a well-defined mesocolon and mesocecum. This was evidently a case in which fusion had failed to occur between the primitive mesocolon and the parietal peritoneum. The mesocolon was traceable to mid-line.

5. In twenty-six cases there was a well-defined descending mesocolon, and undoubtedly instances of a survival of the primitive descending mesocolon.

6. Primitive mesentery. In seven instances the only mesentery proper was a primitive one, attached about the superior mesenteric vessels.

7. Long mesosigmoid. In twenty-five instances the mesosigmoid was unusually long. In one case the omega loop was 28 inches in length.

8. Little fat in great omentum. In forty instances the great omentum contained practically no fat. In four of these forty cases, adhesion had not taken place between the anterior and posterior layers of the great omentum.

9. Mesentery of gall bladder. In four instances the

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gall bladder had a distinct mesentery; in one case it was 2 inches in length. (Now on display in pathologic exhibit.)

10. Extensive adhesions. In forty-five cases there were extensive peritoneal adhesions, both local and general. Especially extensive in regions of gall bladder and appendix.

11. Non-concrescence. In five instances there was no concrescence between the deep layer of the great omentum and the transverse mesocolon.

12. Loss of mesosigmoid. In twenty-three instances there was complete loss of mesosigmoid.

13. Arrested rotation. In four instances arrested or faulty rotation deposited the large intestine entirely to the left of the median plane of the body.

14. There are two varieties of peritoneal adhesions. (1) Physiologic; (2) pathologic. Histologically the two differ in degree only, and I believe it is generally conceded that the physiologic ones are the weaker.

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DISCUSSION.

DR. LEMOYNE WILLS, Los Angeles—I have been fortunate to teach this branch for the past fourteen or fifteen years, and I know of nothing harder to teach a student than the practical understanding of the peritoneum. I think it is a great pity that Dr. Eckley did not have his apparatus here to-day, and I hope to be able to get one and use it. I do not think the practitioners of medicine who have been practicing fifteen or twenty years know very much about anatomy, and it would be a very good thing if we had more papers like this.

DR. RICHARD H. GIBBONS, Scranton, Pa.—This paper is far more important than a peck-measureful of papers on appendicitis. There is nothing that has given me more courage to go out and do my work than the teachings I got from Dr. Leidy on the peritoneum.

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SUNSHINE AND FRESH AIR VS. THE FINSEN ULTRA-VIOLET RAYS AND THE ROENTGEN RAYS IN TUBERCULOSIS OF THE JOINTS AND BONES.

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PHILADELPHIA.

The increasing use of the Finsen light and of the *x*-rays in the treatment of cancerous lesions of the skin and deeper tissues, and especially their use in lupus and other tubercular skin affections, naturally arouses the question of the utility of these rays in the cure of tuberculosis of the joints and bones. The results thus far obtained are certainly sufficient as regards tubercular lupus to warrant the continuance of our efforts in this direction, but the opportunities for noting the effect on deeper tissues in tubercular joints have not yet been sufficient to warrant definite conclusions. A large number of cases will be required to decide the question of benefit, since from the nature of the disease speedy conclusions will be unjustifiable. The course pursued by the tubercular process in joints is always slow, and there are such great differences in the rapidity of progress that the surgeon is very likely to draw wrong conclusions from the results of any method of treatment instituted.

The inhibitory action of the actinic light ray and of the *x*-ray on the growth of tubercular bacilli in the laboratory is undoubtedly positive, and such experimentation is an essential part of our progress in accurate knowledge. Combined with these experiments, however,

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must be careful clinical observation and an accurate recording of facts as they present themselves. I am free to confess at present writing that no definite conclusions can be formulated; only that progress, though slow, is hopeful. At the present time we are erecting at the University Hospital a complete plant for the thorough testing of the therapeutic effect of these light rays, and also of the *x*-rays, and I trust that at the end of five years certain positive data will be secured.

Any method or form of treatment that will tend to retard or inhibit the growth of these bacilli is helpful in the long fight with tuberculosis, and the part of the surgeon must be twofold: First (and I purposely put this proposition first), the fortification of the individual for the conflict; second, the destruction of the enemy.

The secret of success in the battle with tuberculosis of the bones and joints rests overwhelmingly on the resistive power of the individual. While, therefore, the Finsen light and the *x*-ray may have their effect in retarding or inhibiting the growth of the bacilli in a local area, it should be remembered that even the total destruction of this small company means but the temporary crippling of the invading army, and that real safety lies entirely in the permanent upbuilding and strengthening of the resistive powers.

The tubercle bacilli are vegetable parasites subject to the fundamental laws of organic life. Their growth is favored by a lack of resistance of tissues and by a fertile soil. This lack of resistance may be due to traumatism of moderate, rather than of severe, degree, or to temporary constitutional causes, or it may be the result of an inherent and hereditary cell weakness. When special soil and special environment are provided, these bacilli will run a speedy and definite course. That their course can be retarded or totally inhibited is definitely proven both in laboratory and clinical experience. Their growth is facilitated by darkness, dampness, moderate hyperemia and all depressing physical and mental influences. They

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are resisted by light and air and food, and thorough oxygenation of the tissues, by environment, soil and phagocytic defense. The absence of any of these favorable conditions means growth; their presence, destruction of the foe.

The most powerful agents in our possession for the inhibition and destruction of these micro-organisms are sunlight and fresh air and abundant nourishment. The sun's rays are undoubtedly more helpful than any artificial rays, just as natural waters compounded by the chemistry of the Ruler of the universe differ very decidedly from the waters artificially compounded by the chemistry of man.

While experimentally the strongest sunlight in summer takes more than an hour to kill bacteria, yet the ultimate influence is undoubtedly more beneficial than artificial contrivances. The large proportion of hours of sunshine in Colorado undoubtedly has much to do with the reputation of that region for the cure of tuberculosis. The beneficial effect of the sun bath was well known to the ancient Greeks and Romans, and we have been too tardy in again bringing into service measures which they learned from practical experience, and which we in our blindness have overlooked. As surgeons, we can with benefit learn a lesson to-day from the washerwoman and the farmer.

In my own hospital wards I have always considered the sun porch as the most important of all the means of cure. Every tubercular joint case confined to bed, either with horizontal extension or with fixation or traction of joint, spends the entire day at all seasons lying directly in the sunshine, his eyes and head being protected by a green shade attached to the head of the bed. The effect on health, appetite and cell resistance is simply marvelous. When able to walk about, patients are encouraged to play in the sunshine, not in the shade. I have not infrequently sent out into the sunlight and fresh air apparently hopeless cases of joint disease with lardaceous

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organs, and have had them return with sinuses healed, waxy changes arrested and health restored. Of course, it is necessary that surrounding conditions, even in the country, shall be healthful, since many farm houses are unsanitary in the extreme.

In the treatment of tuberculosis of the joints not only are mechanical and operative measures necessary, but all the accessory conditions of health are essential: a superabundance of easily digested and nutritious food, and clothing adapted to the surrounding conditions, in addition to the sunshine and air. There are few individuals who have not observed the influence of darkness and poverty and vice on the general health, and yet few physicians realize the importance of securing the brighter and better conditions. The time is near at hand when sanatoria for the treatment of tuberculosis of the hard parts, as well as those of the soft tissues, will be established. Outdoor life in tents, either in the pine forests or in the hospital grounds, promises a simple practical application of the principles enumerated. Cheeks will grow more rosy, flesh will increase, energy will improve, and resistive power will speedily be such as to control and overcome the tubercle bacilli.

McKenzie and Galloway[1] have also adopted this most excellent principle of treating cases of tuberculosis of joints in the open air by having them live in tents, thus giving patients all the advantages of sunshine and fresh air that are now in vogue in the lung tuberculosis sanatoria. The appetite is greatly improved under such conditions; more food is taken, and it is better digested.

Dr. Flick's regulations at the White Haven sanatorium for consumptives are just as applicable to joint tuberculosis as to phthisis cases: patients to live in tents and to spend their life absolutely out of doors, air to circulate freely through the sleeping apartments, ample bed covering to be supplied. Each patient to take at least three quarts of milk and six eggs a day; more if possible. In addition, a good dinner in the middle of

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the day, and a light breakfast and supper. Dinner of roast beef, vegetables and dessert. The gain or loss in weight are the best indications for adaptation of treatment and food.

Poncet, of Lyons, and Perdu and Blanc[2] have also applied the method practically by exposing joints covered with iodoform gauze to the direct action of the sun for hours in the day. As the case recorded by them, however, had had a previous excision of the knee, the report only shows that the sun's rays acted helpfully in the cure.

Eve[3] applied the light and heat of ordinary electric light bulbs (96 candle power) to a number of cases of arthritis with benefit. Mobility increased and pain was almost entirely relieved. The limb was placed under a canopy made of blankets thrown over a cradle, and the heat raised to 250 F. The beneficial effects of the heat seem to have been increased by the bright light.

Kime[4] uses direct sunlight, concentrating it through an adjustable photographic ray filter, a plano-convex lens of 18 inches focal length and 6 inches in diameter. Behind it, ¾ of an inch distant, is placed a plain plate glass. Between the lens and the plate glass is a space for the blue copper alcoholic solution, which cools the sun's rays and absorbs all but the blue or actinic rays, which are rich in their chemical and germicidal powers. Although such a light focussed to a small point is hot, yet it can be regulated so as only to produce hyperemia, new vigor, new cell action and repair.

Heliotherapy or actino-therapy would probably be the best designation for this method of application of the concentrated sun's rays to the cure of disease; electro-phototherapy for the condensation and application of electrical rays to the same purpose.

Within my recollection, Butler in the 60's, successfully employed sunlight for the treatment of epithelioma of the skin, using for the purpose an ordinary biconvex lens.

Finsen at Copenhagen, Rikli, Koch, Strauss, Arloing

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and others, deserve great credit for their experimental and practical application of the bactericidal action of the sun's rays.

Finsen has shown by his experiments that the blue, actinic or chemical rays, which include the violet and ultra-violet rays, are the only ones that have an especial influence upon animal life and are bactericidal. The red, green and yellow heat rays have no effect upon the micro-organisms. It is the actinic rays which produce sunburn, not by burning the skin, but by slight irritation which produces the pigment deposit. Finsen also experimented with the effect of rays of the sun in smallpox cases, and found that if the patient was kept under red glass and red curtains, etc., that there was no scarring. The concentrated sun's rays have been proven by experiment to be capable of destroying bacilli in a few seconds, instead of hours, and it is also claimed that a concentrated electric light in which the ultra-violet rays are in abundance has a greater bactericidal power than even the sun's rays. These ultra-violet rays in the electric light are in shorter wave lengths, while in sunlight they are of longer wave lengths; the shorter ones have already been absorbed in the atmosphere.

The actinic rays penetrate much deeper into the tissues when the latter are rendered bloodless by pressure or by ice. The passing of the ultra-violet rays through ice renders them more destructive to the tubercle bacilli from the fact that the chilling of the skin by the ice renders it more anemic, and thus gives the rays a better opportunity to act upon the bacilli. Ice is transparent to the violet and ultra-violet, but is opaque to the red and ultra-red rays. Pigmented skins and cicatricial tissue interfere with the penetration of light rays, as does also great vascularity. The skin and intermediate parts should be protected when the *x*-rays are used, but do not need protection, save from the heat, from the Finsen light. In order to retain all the ultra-violet rays (which are the most efficacious) blue sulphate of copper was

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first used, as blue excludes the red rays, but now only ordinary cold running water is employed between the lenses to arrest the red rays and cool them. Finsen also used a lens of rock crystal in place of glass, in order to allow the ultra-violet rays to pass through more easily. The lamps used were from 25 to 75 amperes, since above that strength it was found difficult to cool the rays sufficiently by the use of water. Finsen's large lamps have 35,000 candle power.

In the lamps made in London by Marshall and Woods and Leslie Miller, an interrupted current is used of about 12 volts, and the sitting is prolonged from five to twenty minutes. With some of the new lamps an area of the size of a dollar can be treated at one exposure. In the sunlight baths, Finsen has his patients walk about naked. Finsen's electric bath consists of gigantic arc lights, 100 amperes, suspended six feet from the floor. Patients lie naked on couches. He uses the voltaic, instead of the incandescent, as the former contains more chemical rays. His theory is that the chemical light bath differs materially from the incandescent light baths.

If the *x*-ray can modify local tuberculosis (Muhsam, Fiorantine and others) the Finsen rays are much more likely to produce a beneficial effect.

The lamp now used in the Broca Hospital, Paris, is smaller than Finsen's and more easily handled. The carbon is made with a core of cast-iron, thereby emitting, it is claimed, three times greater amount of ultra-violet rays. The exposures only last twenty minutes, instead of seventy-five, and 30 amperes are used instead of 75 or 80. Anemia of the tissues by pressure is also not considered essential, and the application is made once in two days.

Kjeldsen's lamp is less expensive than Finsen's, and does not require specially trained nurses for its application. Lamps of 5 amperes are employed, and instead of carbon, iron electrodes are used, which are very rich in chemical, and very poor in heat, rays. It is claimed

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that a lamp of 5 amperes gives the same result in three minutes that is given in an hour by the use of 80 amperes with the old apparatus, the cost being about one-tenth, and the assistants required being few. It is also claimed that tubercular bacilli, gonococci and streptococci, and bacteria coli communis were inhibited by the light in five seconds, and that anthrax was killed in thirty seconds.[5]

Widmark, of Stockholm, used but a 1,200 candle power electric light, passing the rays through water to absorb the heat rays, then by carrying the rays through a plate of glass, he excluded the ultra-violet rays and reported that under the influence of all the rays except the ultra-violet, the skin was unaffected; under the influence of all except the heat rays, the characteristic inflammatory symptoms developed. It seems probable, therefore, that the ultra-violet rays produce the known effects of light upon the skin.[6]

Erythema solare may be avoided by care and by the not too rapid use of the rays.

If the current is too strong the skin swells and redness and blisters may appear, but sloughing does not occur. Pyrogallic ointment has been used in lupus to make the skin more penetrable to the rays, and may be also useful in joint disease.

The disadvantages of the Finsen method, which will undoubtedly be lessened when the practical mind of the American applies itself thoroughly to this subject are: first, the limited area of the body which can be exposed to the ray of a single lens; second, the length of time required, and third, the large staff of special nurses that must be engaged. An area of only one and a half centimeters can be treated in an hour.

The cost of the running of the Finsen light is a serious one. A recent estimate makes the expense of a four-light lamp for a year to be $3,000.

As regards the risks, the reaction caused by the ultra-violet rays is much less severe than that following the

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use of the *x*-rays; the heat rays being interrupted by a stream of cold water, there is, of course, less danger of burning of the tissues, and the tanning or sun-burning of the skin renders increasing strength possible.

King has advanced the theory that the parasite of malaria scarcely ever develops except in darkness, and that it may be the red color of the blood that favors its life, while the violet rays interfere with its evolution. His theory of the action of quinin in the cure of malaria is based upon the fluorescent properties of the drug, which act as a destroyer of the malarial parasite, and that esculin and fracsin give the blue rays. Iodin, which is not fluorescent, unites with the starchy substances in the system, forming an intense violet blue. Methyl blue, which has been introduced for chronic malaria, may also act in the blood by producing rays which are injurious to the growth of the malarial parasite. The painting of the skin with methyl blue is said to enhance the efficacy of the rays.

General Pleasanton's[7] "blue glass theory," which was lauded thirty years ago, undoubtedly had some merit. He built his sun rooms with every eighth pane of blue.

The theory advanced by Bean[8] seems reasonable that a restorative change may be effected in a pathologic cell by which instead of being destroyed, its character may be so altered that it becomes again a normal cell. Such a change may be occasioned by exposure to light, by alteration of temperature, or by some vito-chemical alteration or molecular vibration at present unknown to us. Each individual difference in rapidity of vibration of the light waves evidently has its special effect on cells. If such be the case it is not necessary that the rays should have positive bactericidal influence, but only that they possess an alterative effect.

The photo-chemical properties of sunlight and of the electric Finsen light require much further investigation, both as to their physical and their therapeutic properties.

The observation was made long ago that the course of

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tuberculosis differs in brunette and blonde children. Recent observations made upon calves used in the manufacture of animal vaccine, show that the pustules do not develop as well in animals with a dark hide, but that the light-skinned ones are preferable.

Light rays cause contraction in living protoplasm,[9] but Hammer does not believe in the direct action of light on the blood corpuscles. He supposes that certain nervous elements of the skin, in connection with the pigment cells, are put in motion by the ultra-violet rays, and that this motion leads secondarily to hyperemia, inflammation and pigmentation. His experiments on tadpoles, salamander eggs, earthworms, etc., endeavoring to explain the phenomena and to study the relationship between motility of cells and monochromatic light are interesting in showing that light provokes movements in the fetus, and that this faculty must be attributed to the violet rays. White light causes sensibly less action. It is the chemical ray undoubtedly which is the special agent in influencing cell action. Electric light baths and incandescent lamps contain very few chemical rays, not, in fact, as many as ordinary daylight. They can not, therefore, possess the influence of sunlight. These electric light baths probably affect the cells through their heat rays, while a chemical light bath acts differently.

The Roentgen or *x*-rays have been used by myself, by Murphy and a number of other surgeons in the hope of influencing the tubercular process in joints and bones. As remarked in the earlier portion of this paper, it is too soon to determine results, for the reasons there set forth.

The *x*-rays have been proven to have an inhibitory influence not only on the tubercle bacilli, but also on the cholera spirillum, the prodigiosus and the colon bacillus. In the laboratory, after twenty to thirty minutes' continued exposure to the rays, many of the bacteria are killed, and multiplication ceases in nearly all. Some of the micro-organisms, however, survive. Experiments on animals do not seem to warrant the conclusions

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that the same action can be expected when these pathologic cells are surrounded by living tissues. Animals inoculated and exposed to the *x*-ray have died sooner than similarly inoculated animals not thus exposed.[10]

Various theories have been advanced as to the method by which the *x*-ray energy is exerted on the cells; each theory has been succeeded by another as equally plausible, but all lack positive demonstration.[11]

The bactericidal power is apparently not due either to the heat, the fluorescent light, electricity or ozone.

In our present state of experimentation various therapeutic methods will be employed. One of these has been the alternation of the Finsen with the *x*-ray; Finsen one hour; *x*-ray, five to eight minutes. The Finsen light has less penetrating power than the *x*-ray, but the combination of the *x*-ray to destroy the germs and the Finsen to act as a curative agent seems to be most advisable. The hard *x*-ray tubes have apparently greater penetrating power than the soft. Tanning of the skin is best done by the slow process. The skin and intermediate parts should be protected when the *x*-rays are used, but do not need protection from the Finsen light, save by cooling.

The amount of irritation produced by the *x*-ray on a part depends on various conditions; the distance from the tube, the time of exposure, the hardness or softness of the tube, the cutaneous idiosyncrasy of the patient, the length of exposure and the personal equation of the experience of the operator. Undoubtedly, however, the nearer the tube and the longer the exposure, the greater will be the danger of burning.

The experiments with *x*-ray on cancerous growths, especially of the skin, and even of the deeper tissues, leads to hope that the life process of tubercular cells may be altered, and that destructive changes may be retarded, if not altogether inhibited.

The superficial effect of either the Finsen or the *x*-ray

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on lupus can not be taken as a guide to their effect on deeper tissues in the joints and bones, yet we may reasonably hope that if the former can be influenced, human ingenuity will in time discover a method for the alteration of deeper tissues. In this connection it is interesting to note the recent achievements of Goodspeed that the wave or ray emanations from the human body are sufficient to impress a photographic plate. Very remarkable also are the continuous forces emitted from that new metal, radium. With the advancement of science and of medical knowledge, tuberculosis must and will be conquered.

The application both of the *x*-ray and of the Finsen light is rapidly becoming wider in its scope, but they should be used not as a substitute for mechanical and operative measures, but to supplement them, and to improve or cure the inoperable cases.

CONCLUSIONS.

1. Sunlight, fresh air and good food, together with fixation and protection of the affected joint, are the most important agents in the contest with tubercular infection.

2. Direct exposure to the rays of the sun is essential, and all hospitals should be provided with solaria or sun porches and roof gardens.

3. Patients lying in bed should have the diseased joints exposed to the direct rays of the sun, their heads and eyes being protected by green glasses or shades. The joints may be covered with blue, so as to secure easiest passage of the ultra-violet actinic rays, and local medications rich in iodin may be also employed as desired.

4. Tent life on the hospital grounds, or better, in the open pine forest, can be successfully employed through both summer and winter.

5. Sanatoria should be established for tuberculosis of the hard tissues, as well as of the soft.

6. The concentration of the sun's rays by lenses, as

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suggested by Butler, Finsen and others, is of positive benefit in bactericidal influence. As final curative agents, however, the direct sun's rays are most effective. Electrical rays can be used when sunlight is lacking.

7. The Roentgen rays in the laboratory have an inhibitory power on the tubercle bacilli, and may prove useful in restraining the growth of these micro-organisms in living tissues.

8. The actinic rays and the *x*-rays are both apparently helpful in the fight with tuberculosis, but several years will be required to determine accurately their effect. They should be employed not to supercede, but to antedate and to supplement operative procedures, to assist the mechanical protection of the joint, and to increase the general therapeutic measures employed.

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A STUDY OF THE HISTOLOGIC CHANGES IN EPITHELIOMA UNDER THE *X*-RAY.

A PRELIMINARY REPORT

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The striking and unforeseen curative effects of the Roentgen ray on epitheliomata make it probable that a careful study of the histologic changes occurring in these tumors while under treatment must prove both interesting and instructive.

Medical literature is rather barren in studies of this sort, most opinions put forth being founded on insufficience or absence of observed facts. Note the opinion solemnly set forth in a journal devoted to the exploitation of *x*-ray work: "The beneficial influence which the agent (*x*-ray) undeniably exercises on superficial cancer is due to *x*-ray vibrations acting on the cell elements of the growth, which elements are too weak and lacking in vitality to reach maturity and become the specialized tissue for which they were destined of themselves, in such a way as to give them new vitality, and hence ability to reach maturity and their normal ultimate structure."

That is, the *x*-ray is a sort of reformatory treatment by which the erring cancer cells are spanked and brought to a realizing sense of their vagrant ways, become reformed and proceed to grow into normal adult tissue; a very beautiful effort of the imagination, but needing a substratum of facts.

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Many equally remarkable explanations of the *x*-ray effect could be quoted, but this one will suffice.

Dr. A. G. Ellis has made an important contribution to this subject from a strictly scientific standpoint in the *American Journal of Medical Sciences,* January, 1903. He studied four cases, two of which were epithelioma, which had been subjected to varying amounts of exposure to *x*-rays, and has determined some interesting facts. As he gives the literature at length, it will not be necessary to quote authorities.

Fig. 1.—Photograph of Case 1 before treatment.

His conclusions are that the study of these cases shows: 1. Necrosis of cells and trabeculæ of varying degree. In Case 1 (a cancer of the breast) there is marked fatty degeneration. 2. Increase of elastic tissue. 3. Fewer areas of lymphocytic infiltration in one case after exposure, about equal numbers in others. 4. A tendency to occlusion of vessels by deposits on their inner surfaces. 5. Practically entire absence of infiltration by polymorphonuclear leucocytes. He says: "The

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unsatisfactory clinical results, as well as the slight microscopic changes in Case 3 (epithelioma) can probably be safely attributed to the presence of the exceedingly numerous keratinized areas or 'pearls.'"

The results of the present study are quite at variance with the above in many respects, as will be seen later. The larger part of the material studied was obtained

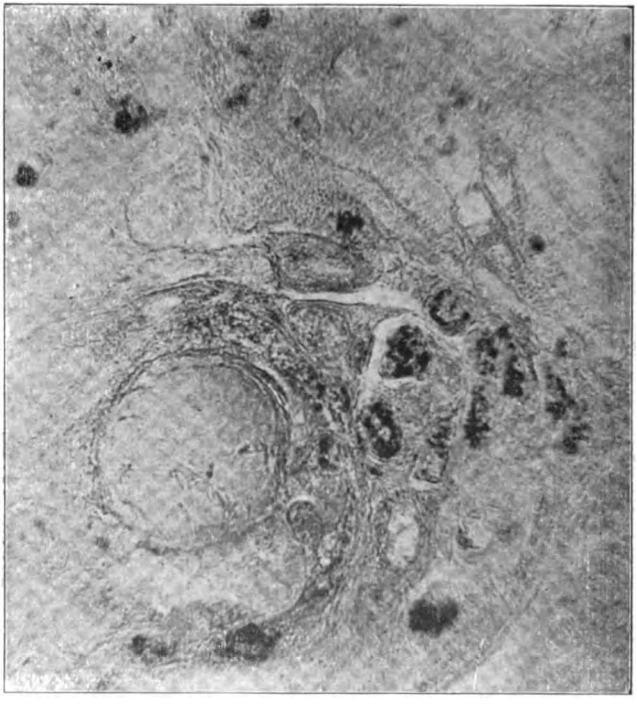

Fig. 2.—Fatty degeneration in epithelial pearl. Hermann fixative 500 diameter.

from one case, which came under observation Dec. 10, 1902, and the research work was begun December 18, some time before the publication of Dr. Ellis' paper.

Case 1.—A. B., Norwegian, aged 52, single, gave the following history: Eighteen months ago he cut the back of his right hand with a beer bottle, and the cut became infected and healed slowly with a dense raised scar. Soon after an elevated wart-

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like growth appeared in the scar, which was repeatedly cauterized with pure carbolic acid without much effect. His general health has been good. There is no cancer in his ancestry or environment. An examination shows a fungus ulcer about three inches in diameter on the back of the right wrist. It is raised above the skin more than one-half an inch, the elevation being greatest at radial edge. The extensor tendons of the fingers move freely, but just at their radial side the growth has deep attachments. There is no enlargement of the axillary lymph nodes. In view of the impossibility of excision it was decided to subject the growth to *x*-ray treatment, as it seemed the only chance of saving the hand.

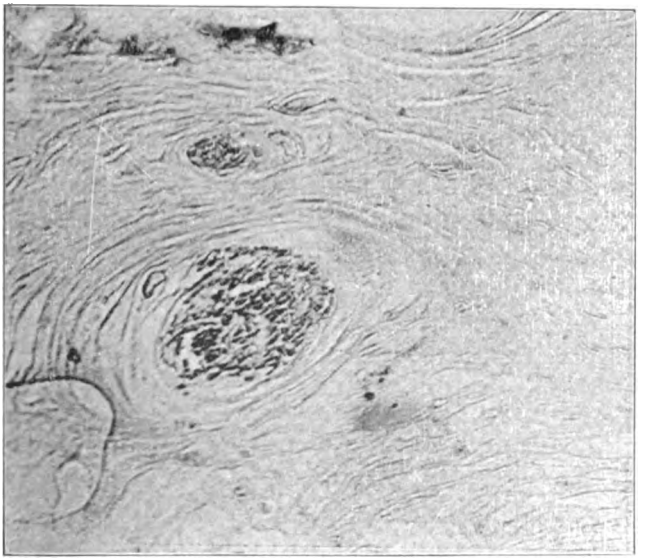

Fig. 3.—New blood vessel containing red blood cells in center of epithelial pearl.

On December 10, 11 and 12 he was given twelve minutes' exposure to a one-inch tube at five inches. . On December 16 and 17 he was given fifteen minutes at five inches. On December 18 the first block was excised, being cut from the non-sensitive surface of the ulcer, half an inch from the skin edge. December 22 and 23 he was given twenty-five minutes' exposure to a low tube at five inches. December 23 block excised. December

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29 block excised. From December 29 to January 2 he was given daily twenty minutes' exposure to a low tube at five inches, and blocks were removed every other day until the whole fungus part of tumor had been softened and came away. In all, seven blocks were secured, covering the time from the fifth exposure up to the eighteenth, in all, thirty-six days.

HISTOLOGIC CHANGES NOTED.

Each block was cut in three portions and fixed in

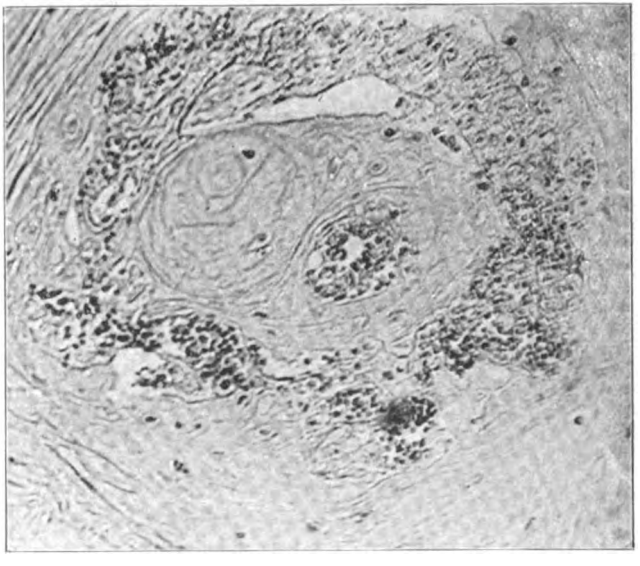

Fig. 4.—Circle of new vessels in epithelial pearl.

different fixatives. Hermann, Mann, Zenker and 25 per cent. formalin being used. The blocks were carried up, embedded in paraffin and cut in sections of from three to ten microns in thickness. The sections were examined unstained from the Hermann fixative for fat, and others were stained in various ways. The Hermann sections were washed in ether to differentiate fat from other substances taking osmic acid. Hematoxylin and eosin, hematoxylin and Van Gieson, Weigert's resorcin

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stain for elastic fibers, and Pianese IIIb for degenerations, Plimmer's stain for parasites were used. By these methods quite a number of changes could be made out, which can be briefly tabulated as follows:

1. *Fatty Degeneration.*—This is marked in all sections from all blocks. In the early sections it is most

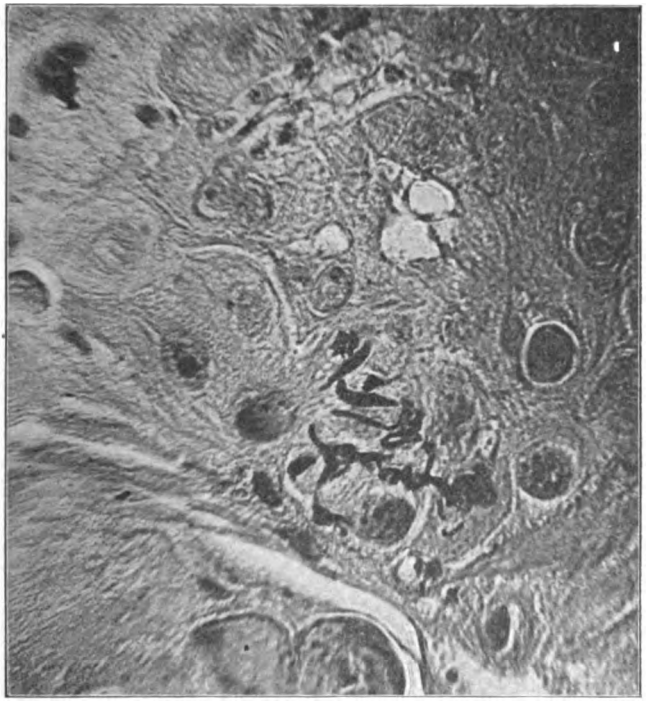

Fig. 5.—Elastic tissue. Weigert resorcin-safranin.

marked in the epithelial cells at the periphery of the pearls, the fat occurring as granules grouped about the nucleus, and in many cases in the nucleus itself. Fat exists, however, in a large percentage of the epithelial cells, and this infiltration seems to increase with the number of exposures to the *x*-ray, until the cells disintegrate, when in the final stage of detritus it is seen mainly

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in the leucocytes, either as a degeneration, or possibly as a phagocytic inclusion.

In view of Unna's statement that fatty degeneration does not occur in epitheliomata, this is certainly a noteworthy effect of the treatment.

2. *Vascular Changes.*—In the earliest slides there are marked evidences of the formation of new blood vessels. They are seen between the epithelial cells and noticeably

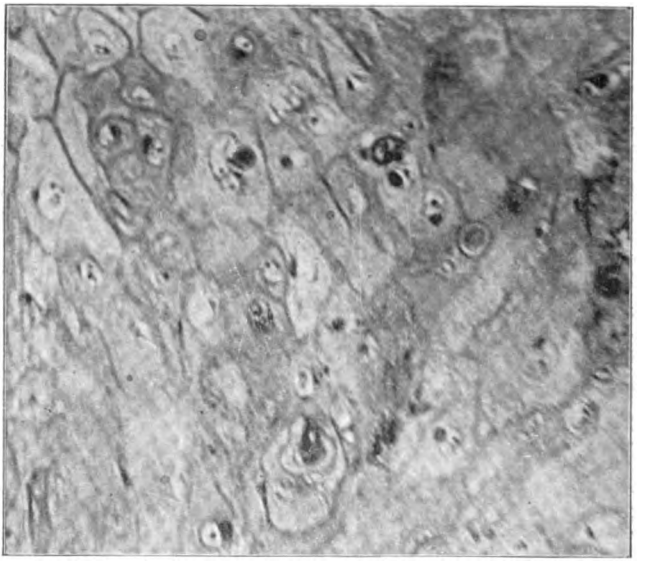

Fig. 6.—Shows hyaline cell inclusion similar to Plimmer bodies.

in the centers of many pearls. They are at first filled with red blood cells with an occasional white cell, but later the red cells disappear and the vessels are packed tightly with the polymorphonuclear leucocytes. These leucocytes are also seen between the epithelial cells, and finally separate them into bands and detached cells surrounded by a reticulum filled by white cells.

3. *Elastic Tissue.*—Weigert's resorcin stain shows considerable elastic tissue in fibers and granules, usually

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in the immediate neighborhood of a new vessel, but not in its walls.

4. *Hyaline Degeneration.*—As this degeneration is a regular part of the life history of an epithelioma, it is not surprising that it should form a large part of the picture in many of the sections. It is especially noticeable in both pearls and single cells about the middle of the series, being replaced by coagulation necrosis in the latest slides. In many of the later slides the hyaline

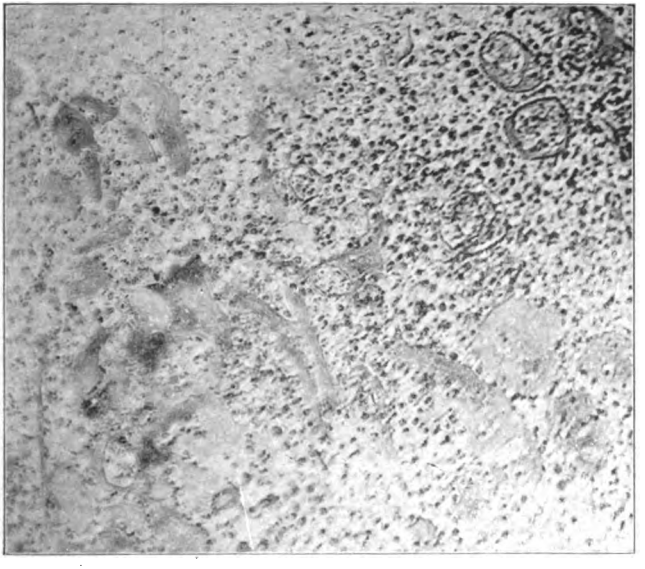

Fig. 7.—Shows general breaking down with infiltration of leucocytes into and between the epithelial cells, hyaline degeneration of the cells and at outer edge coagulation necrosis of whole mass.

bodies of Unna are plentiful, as well as many cell inclusions, which, stained by the Pianese IIIb, or by Plimmer's method, are indistinguishable from the so-called Plimmer and Russell bodies as figured by Gaylord. As these do not appear in the early sections, but only when karyokinesis has ceased and degeneration of various kinds are very marked, it is difficult to understand how these fuchsin bodies can have any etiologic

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relation to cancer. They are indistinguishable as to staining reactions from the other hyaline bodies noted above.

5. *Necrotic Changes in Cells.*—In some of the early slides karyokinesis is well marked, but later it entirely disappears, except an occasional cell in blocks taken from near the skin border of the ulcer. Chromatolysis begins quite early and increases until in the last sections there is hardly an intact nucleus. At the same time there is fusion of the cell bodies and loss of all cell outlines. Hyaline degeneration of single cells is very common, as before stated, as are the fuchsin bodies.

6. *Final Result.*—The latest sections obtained before destruction and liquefaction show an interesting and remarkable picture. Nothing is left of the epithelial structure but some dimly staining masses of cells in coagulation necrosis, with the rest of the section composed of a fine reticulum taking the acid stain, having its spaces filled with polymorphonuclear leucocytes, fragmented nuclei and other detritus, while interspersed through the mass are small clumps of epithelium and single cells, which have no nucleus and have lost their outline, and are just ready to pass into coagulation necrosis. In areas where the final fluid detritus was confined the microscopic appearance was like a so-called laudable pus, and the microscope showed only polymorphonuclear leucocytes, broken-down epithelia and free fat.

The study of sections from other epitheliomata, after varying exposure, gave results corresponding to the above, although in small growths it was impossible to get more than one or two blocks. One case especially, an epithelioma of the ear, after four ten-minute exposures, gave a picture like the final one from Case 1, except that the leucocytic infiltration was almost entirely composed of plasma cells, instead of the polymorphonuclear form.

It will be noticed that there are several very striking differences between the results of the study noted above,

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and those obtained by Ellis in the two cases of epithelioma studied by him. These are the vascularization and the leucocytic infiltration which are probably only phases of the same process, and the difference was probably due to the destructive effect of the treatment in my cases, as compared with the negative clinical effects noted by him.

Certainly his explanation of the resistant character of the pearls, preventing curative effects, seems doubtful, at least, in view of the very early and decided changes in them noted above.

The explanations offered by some writers that the degenerations observed and final necrosis are due to decreased blood supply, which is caused by the thickening of the inner coats of the blood vessels, find no support in this study, as the abundant formation of new vessels and their distension makes improbable any obliteration of the different vessels. Unfortunately, none of the sections cut were from locations which could give any information as to whether the endarteritis observed by so many was present.

It seems probable that different epitheliomata may offer different degrees of resistance to the disintegrating effects of the *x*-ray, just as their bearers may show different degrees of susceptibility to the burning effects of the ray, but when necrosis is finally attained there will be characteristic changes in the cells.

It is to be regretted that sections were not taken from Case 1 before treatment, and more frequently during the active treatment, but the idea of making a study of the case occurred only when rapid results began to be noted after four treatments, and the subsequent progress was so rapid that all available tissue was destroyed when the seven blocks were obtained.

It may be of interest to hear the subsequent history of this case which began so auspiciously. Early in January, after some six weeks of treatment, all the elevated portion of the growth was destroyed and there was left

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a deep portion which extended into the bones of the carpus, and under the small tendons of the thumb toward the wrist. After wasting a great deal of time in a vain attempt to cause necrosis of the deeper parts, a small, apparently new growth was noticed at the radial edge of the ulcer. This determined an erasion under an anesthetic, which showed that the growth had progressed under the skin at the radial edge of the ulcer, in spite of vigorous *x*-ray treatment. All the epithelioma was carefully scraped away, and all overlying skin was excised, as well as the small extensor tendons of the thumb, which were hopelessly involved, and there is now a clean defect, with no signs of epithelioma, which is healing rapidly under mild *x*-ray treatment.

The tissues excised, which included nerves, tendons, vessels and new-formed scar, all exposed to many *x*-ray treatments, will furnish material for a later communication.

CONCLUSIONS.

1. It is probable that when epitheliomata react favorably to *x*-ray treatment that characteristic histologic changes will be found.

2. The important early changes are fatty degeneration and vascularization of the epithelial pearls.

3. Leucocytic infiltration and various degeneration processes complete the destruction.

4. Bodies indistinguishable from "Plimmer's bodies" multiply as epithelia degenerate.

NOTE.—I wish to acknowledge with thanks the aid in this study of Prof. Margaret S. Nickerson, Drs. Louis B. Wilson and Arthur T. Mann, without whose assistance the work would have been impossible.

DISCUSSION

ON PAPERS OF DRS. WILLARD AND STEWART.

DR. HENRY A. CHRISTIAN, Boston—I wish to add one case to the report of Dr. Stewart, a case of epithelioma of the back of the hand of the distinct cauliflower type. Before any treatment was undertaken a portion of the tumor was excised and sent to the pathologic laboratory of the Boston City Hospital for examination. It was a typical specimen of epithelioma,

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with the usual cell nests and with no particularly marked amount of inflammatory reaction. After treatment for a considerable length of time a second portion was excised. Pathologic examination of this showed that the epithelial cells in the cell nests were dead. They no longer stained and, what is particularly interesting, they were in many places surrounded by foreign body giant cells. In other words, the dead epithelial cells had changed from a living acting part of the growth and now simply acted as a foreign body and were being destroyed by the giant cells. There were no polymorphonuclear leucocytes present. There was no change in the connective tissue cells, while the epithelial cells were entirely dead.

Another point of interest was that a portion of the hand protected by the lead shield and supposed to be non-carcinomatous, i. e., to lie beyond the border of the growth, was in reality carcinomatous. This portion protected from the ϖ-rays by the lead shield showed no such change. In other words, the epithelioma survived where the lead shield protected the growth; and there was death of the cells where the lead shield did not protect it.

Just what the process in these cases is I am not prepared to say. I do not think that too much importance should be placed on the fatty degeneration described by Dr. Stewart. Fatty degeneration has, so to speak, lost in recent years some of its pathologic standing. We no longer look on it as such an important degenerative process. Then, fat is frequently present in cells of the body under normal circumstances. Furthermore, the reagents used by Dr. Stewart for obtaining the reaction demonstrating fat are open to some objection. The main reagent used was osmic acid. We know that osmic acid stains other things than fat, for instance, certain keratin granules in the epithelial cells of the skin, also, the fatty substance of the sebaceous glands. Now, as the epithelioma originates from the skin these substances normally present must be borne in mind. If a substance stains black with osmic acid, this is not positive proof that it is fat, nor is the presence of fat always evidence of a degeneration.

Another interesting point is the presence of fat in the polymorphonuclear leucocytes. This occurs very frequently; in fact, it is generally present where there is an inflammatory process. It is also to be found in the polymorphonuclear leucocytes circulating in the blood. This is true particularly where there is a marked leucocytosis. I have had an opportunity to study these cells, particularly in association with pneumonia, and have found fat very constantly present in them.

Another point on which emphasis was laid is the great number of polymorphonuclear leucocytes present in this case. Is that due to the effect of the x-ray or to something else?

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In this case I understood that the surface skin was ulcerated. In such a condition you would expect to find polymorphonuclear leucocytes present at the outset. Again, when we have polymorphonuclear leucocytes and an inflammatory process we generally have the formation of granulation tissue; in other words, the formation of new blood vessels, so that the statement that the formation of new blood vessels is caused by the *x*-ray is possibly also open to criticism. I think the fact that the epithelial cells are dead, as shown by the case reported by Dr. Stewart and the case I have reported, are rather important factors. It is possible that simple inflammation may have had something to do with the formation of the polymorphonuclear leucocytes and the new formed blood vessels. The question remains open as to how far fatty degeneration, inflammation and cell death are due directly to *x*-ray action. Very general conclusions are not, of course, to be drawn from single cases.

Dr. Edward H. Nichols, Boston—I agree with the beginning of Dr. Stewart's paper, but there are one or two things later on which I am compelled to differ with him. In regard to those lesions which were selected for this *x*-ray treatment as epidermoid cancer or epithelioma, which, after a greater or lesser number of treatments, have disappeared, the ulcers healed over, the capillary growth melted down and entirely disappeared and new skin formed, such cases are constantly being reported as cured. I think we should consider all those statements of cures with the greatest suspicion. It is true that for some reason or other the surface condition has apparently improved. The fact that the new skin has formed over the area of the wound is far from proving a cure of that case of cancer. I have had considerable opportunity during the last three years of observing the histologic changes following *x*-ray work. The cases referred to by Dr. Christian I have had the opportunity of seeing. The changes as we have seen them following the use of the *x*-ray have shown no peculiar characteristics. The changes in cases of epidermoid cancer treated by the *x*-ray show, as a rule, an increase, and in many cases stimulation of the cells. And I would defy anybody to recognize this change as a characteristic one. You see exactly the same changes as you would see in cases of degenerative carcinoma, and this has been deemed by some men to be due to the action of the *x*-ray on certain portions of the epidermoid growth, but they are really indications of the growth of the cancer. The *x*-ray acts as an irritant, and acts on those portions of the cancerous growth which are less resistant than the sound tissue. I think it can be perfectly explained by saying that the *x*-ray acts as a mild irritant, not producing burns, yet sufficient to cause increase in the epithelial cells at first and later disintegration. One

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other thing that needs to be borne in mind is that the *x*-ray can also produce epidermoid cancer. At a meeting of the American Dermatological Association a year ago last August, a case was reported of extensive epidermoid cancer of the hands of a man who had been using the *x*-ray, followed rapidly by metastasis. There is at the present time an operator in Boston who has lost three fingers on one hand and two on the other due to extensive epidermoid following rapidly after very extensive *x*-ray irritation, he having had a distinct *x*-ray burn. In regard to the bodies that Dr. Stewart mentioned, I have seen their work in their own laboratories, so perhaps I can express an opinion, and I have seen the definite Plimmer bodies of Greenough, and I do not think these objects seen by Dr. Stewart were the Plimmer bodies. I think every surgeon should bear in mind very carefully the fact that the *x*-ray is liable to produce cancer. In certain cases it may do good, and for that reason I think it is better to first remove the epidermoid cancer and then use the *x*-ray, and in certain cases it may be of advantage, but I think in all cases operative treatment should be the first procedure.

Dr. John Ridlon, Chicago—In regard to the treatment of tuberculosis of the joints by sunlight, I do not think that we should assume too large a hope in this direction. Sunlight or any other light alone does not cure tubercular joints; they must be treated by mechanical means, immobilized, or else no good can result from the exposure to the sunlight or any other light. As to the effect of sunlight on tuberculosis of the joints, I am somewhat in doubt as to whether it is likely of itself to produce beneficial results. All of us who practice in large cities and large towns can see great gain if a child is exposed to the sunlight. On the other hand, in the case of tubercular joints in the children of farmers and people who live in the country, who are more exposed in the sunlight and fresh air, there is usually not so much improvement from further exposure to sunlight and open air. It would seem then that from clinical observation it is the change of environment that has the effect rather than the sunlight and air without the local environment.

I have had no personal experience with the *x*-ray treatment of tuberculosis. My office associates, Dr. A. D. Harmer and Dr. John L. Porter, have done considerable experimental work with the *x*-ray on tuberculosis of the joints, and such cases as we three together had that seemed to be favorable for experimental work we have subjected to that treatment. The cases were those in which the progress had been unfavorable under ordinary mechanical fixation. It was thought only fair that such cases should be selected and not those which were doing well under ordinary treatment. A considerable number have been subjected, during the last year and a half, to the

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x-ray treatment. Many have improved more rapidly than could have been expected without this treatment. The number, however, has not been sufficiently great for us to form any trustworthy conclusions. It has reminded me very much of the iodoform injection treatment, which was very much in vogue about ten years ago. Almost all of us used these injections of iodoform in the cases of tuberculosis, and we all thought that we were getting better results. We all know now that the injection of iodoform into tuberculosis of the joints is practically useless. So I fear that this *x*-ray work will turn out in the same way, and that, although a certain number of those cases do appear to be cured, it will not amount to very much. What we have learned is that when the superficial joints are benefited by the *x*-ray there must be very marked irritation of the skin. Tuberculosis of the hip joint and of the spine have not been benefited. Dr. Harmer has deliberately burned the skin in many cases, and he has found that he does not get as good results when the skin is not subjected to strong irritation.

Dr. Fred. B. Lund, Boston—I have seen, during the past five years, cases of cancer treated by the *x*-ray. Surgeons recognize that epithelioma of the face, particularly of the rodent ulcer type, is a non-malignant form, that recurrence is slow, and that in the cases that have recurred there has usually been no glandular involvement. I have seen a great many cases of cancer of the face, many of the rodent ulcer type, that were really benefited by the *x*-ray treatment, and leave a most excellent scar, and some of our surgeons in Boston have stated (very prematurely, it seems to me) that the day of the knife in the treatment of epithelioma was past, and that we had no business to use the knife in those cases, but that they should be turned over to the *x*-ray treatment. On the other hand, I have seen some very sad results following that advice. A patient came in suffering with an epithelioma of the lip in a very early stage. Glandular involvement appeared soon after it was exposed to the *x*-ray, and he was treated by the *x*-ray without the slightest results. I have seen a number of cases of recurrent carcinoma in the breast glands treated without the slightest result. There are a certain number of cases of epithelioma of the face, of the more malignant type, in which it is of no value. I operated three years ago on an old lady 68 years of age. The cancer was excised and the wound covered with skin grafts; excellent results followed for a time. Then recurrence took place, and I excised the growth under local anesthesia. After operating on her 12 or 15 times, I tried the *x*-ray treatment for six months. At the end of this time the growth recurred with extraordinary rapidity, and the soft parts of the nose had to be excised down to the nasal bones. In other words,

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it seems to me that the *x*-ray is in the nature of a mild irritant or caustic, that it has an excellent influence on non-malignant growths, but that the malignant growths had better be excised. The ideal way perhaps is to first excise the growth and then in case of recurrence use the *x*-ray, but temporizing with the *x*-ray in the first instance is not only useless, but dangerous.

Dr. John W. Brandau, Clarksville, Tenn.—Is there any effect produced on the kidneys by the use of the *x*-ray in cancer of the cervix? In the past few months I have treated two cases of carcinoma of the cervix. One was of the cauliflower type, the other hard cancer. I had excellent results in both so far as the cancer was concerned. The cauliflower cancer underwent rapid degeneration, and after ten treatments of fifteen minutes each every second day the cervix was practically normal in size. In the other case the effect was very different. There was sloughing of the cervix after seventeen treatments covering a period of three months. In both cases the pain was extreme previous to treatments; opium in some form being administered. After the second exposure there was no more need for opium. One of the women went to her home apparently cured of the cancer to await the results of the sloughing, with instructions to return in the course of three or four weeks for examination. In about four weeks there was suddenly almost complete suppression of urine, which was highly laden with albumin. In a few days she died from uremia poisoning. The other case died about eight weeks after treatment was discontinued from exactly the same cause, and what little urine I could get by catheterization was almost solidified by albumin on boiling. I would like to know whether any of the other gentlemen present have observed any bad effects on the kidneys from this treatment.

Dr. J. E. Thompson, Galveston, Tex.—A few months ago a young man 29 years of age, with a large tumor over the stomach, was operated on, and it was found that the entire anterior part of the stomach and the lesser curvature was involved with a growth that afterward proved to be an epithelioma. There was almost complete obstruction of the pylorus for several weeks before the operation. I did a posterior gastroenterostomy and got immediate relief of the symptoms of obstruction. The growth appeared to be an extensive one, and about three days after the operation it occurred to us that it might be well to try the effect of the *x*-ray on this tumor. About forty-eight hours after the operation, I believe, we reopened the wound and packed the opening between the peritoneal parieties and the tumor, leaving this mass, which was about the size of a large orange, in the wound. We got profuse exudate. After 24 hours it ceased. We took out our

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own packing and found that the mass had been transformed into an external one. We then commenced the use of the *x*-ray, and after having used it for about a week, we noticed signs of increase in size, and a few days later the mass broke down and discharged profusely a cheesy matter mixed with pus. It then became apparent to us that we were going to have a fistula, because sloughing was extensive, and a few hours later, the nurse came to me and informed me that there was something in Mr. A.'s bed that looked like his breakfast. We found this to be true. A large opening was found in the stomach. We succeeded in packing this off, so that the patient could retain food sufficientiy long to pass through our very large anastomosis into the bowel. He went to bed, was comfortable, took his nourishment well and enjoyed it. He seemed to have an especial liking for such indigestible foods as ham and bacon. He improved slightly in weight for two or three weeks, when he began to go down, and after about a month died from extreme emaciation. This, to my mind, seems to teach us some very interesting points. One is that we can not break down hard epithelioma with the *x*-ray. The second is that it is rather dangerous to try to break down a cancerous growth in the abdominal cavity. Third, the *x*-ray did not appear to have any prominent effect in checking the general growth of the epithelioma, which had become metastatic at the time of the operation.

Dr. De Forest Willard, Philadelphia.—In answer to the question as to whether a blue medium is of value either with the *x*-ray or with the Finsen light, or with sunlight, it seems to me to depend entirely on the power of the medium to increase the force of the ultra-violet rays. Since the ultra-violet rays are therapeutically the potent ones, of course, the larger the proportion the better will be the result. The rays have proven themselves of value already in superficial tuberculosis and cancer, but we have by no means achieved the limit of possibility in the use of the sun's rays. I stated in my paper that we should use these agents as supplementary to our general treatment and not depend on them entirely. In regard to the use of the *x*-ray in tuberculosis, the benefit has certainly been sufficient to encourage me to use it further. Its influence in cancer and epithelioma has in my hand been helpful, but not curative. The Finsen light and the *x*-ray are still only in the experimental stage, and I have no anticipation that they will do more than act as accessories to general treatment. I expect to test them for five years. I do not expect to obtain any results that will be of value in a shorter time.

In reply to Dr. Ridlon, I would say that in my conclusions, I stated that sunlight and fresh air should be employed, "together with fixation of the joints." In another conclusion I said that this method should be employed, "not to supersede,

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but to supplement the mechanical and operative appliances." I took it for granted that no element would be neglected, and particularly the mechanical fixation, which is so important, in fact the most important element in inhibiting a destructive tubercular process.

In regard to the criticism that many farmer's children who live in the open air have tuberculosis of the joints, I would say that I have not infrequently found farmers houses in far more unsanitary conditions than prevail in the city.

Our patients are benefited in the city hospitals largely because we bring them out of the darkness, and give them good food, in addition to mechanical appliances.

The point that I wished to emphasize was that, in addition to all our other methods, we should employ sunlight, the *x*-ray and the Finsen ray, in fact everything that will help us in the desperate fight with joint tuberculosis.

DR. J. CLARK STEWART, Minneapolis—In answer to Dr. Christian I would like the permission of the chair to ask him a question, and that is, whether the washing of sections stained by osmic acid in ether and thus discharging the black color does not prove the blackened substance to be fat. The technical work was done for me by Prof. Margaret Nickerson of the University of Minnesota, and I am confident that Dr. Christian may accept all statements of fact as correct. In regard to the fatty degeneration, as I stated in my paper, the slides were washed with ether, demonstrating the presence of large amounts of fatty degeneration, and as Unna states that fatty degeneration never occurs in epithelioma, this pronounced fatty degeneration was considered worthy of mention. In regard to the vascularization being simply that of granulation tissue, I would say that the presence of the vessels long antedated the presence of anything which could be termed granulation tissue, and even of the leucocytes themselves. Later, where at first red blood cells had appeared in the new vessels, these were crowded with leucocytes, and still later, the leucocytes infiltrated the extravascular tissue. All the changes described in my paper were distinctly progressive during the treatment of the case. I don't attach much importance to the polymorphonuclear form of leucocytes in these sections as in two other cases where the resulting changes were about the same, the leucocytes were entirely of the plasma cell type. I was glad to hear Dr. Nicholls' remarks about the nonoccurrence of Plimmer's bodies in epithelioma. The bodies figured by me closely resemble those pictured by Gaylord in his article in the *American Journal of Medical Sciences*. The study of these cases shows certain positive results which must be of more or less value in explaining the results attained by successful treatment.

In regard to Dr. Willard's paper I can add just one observation of interest. I have treated one case of caries sicca of the

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shoulder joint with rather striking results. These cases, as you know, usually go on to ankylosis after about two years' disability, while the case under consideration attained about the same result after two months' treatment with the *x*-ray. Apparently the cicatrization and contraction of the tubercular tissue about this joint was very greatly hastened by the effect of the *x*-ray.

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VARIX OF THE INFERIOR MESENTERIC VEIN COMPLICATED BY CHRONIC ULCERATIVE COLITIS—OPERATIONS.

J. E. SUMMERS, Jr., M.D.
OMAHA.

I am led to report the following case because the condition found is unusual, or has at least received scant attention at the hands of pathologists. For this reason I will give the history somewhat in detail.

History.—Mr. B., 34 years of age, was referred by Dr. I. Lukens of Tekamah, Neb. The following was elicited: When two years of age he began to suffer from prolapsus of the rectum and never received permanent relief of this condition until 27 years old. He was a rather puny boy and was not a robust man, although able to attend school and perfect his studies so as to become a competent school teacher. During all these years there had been a constant tendency toward rectal prolapse.

When 27 years old Mr. B. underwent an operation, some tumors were removed (probably hemorrhoids), three ligatures being employed. Following the operation the patient enjoyed fairly good health until the spring of 1901, when his general health became poor. In August, 1902, as the result of doing some unusual manual labor, the lifting of heavy joists, he was attacked with frequent desire to go to stool and the passing of considerable quantities of mucus and blood. During several days the mucous bloody discharges alternated with the passing of hardened feces; this condition was succeeded by an attack of diarrhea. Because of poor control of the bowels a pad had been worn continuously to prevent soiling by the discharges. The alternating attacks of constipation and mucous discharges continued from August, 1901, to March, 1902 when the man came under my care in the Clarkson Hospital.

At this time Mr. B. had the appearance of ill health, and poor nutrition; on examination the anal sphincter was found weak and incompetent, the rectum to the touch and by inspection was the seat of five ulcerations of different sizes, one being as

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large as a silver dollar and the others smaller. On introducing the sigmoidoscope numerous ulcerated patches were observed in the sigmoid. The edges of all ulcerations were elevated, and where palpable were, together with their bases, rather indurated; the surfaces were pale.

The treatment ordered was irrigation of the bowel, with bland or stimulating solutions of salt and silver nitrate; the recumbent position was insisted on and a restricted but nutritious diet prescribed. Little improvement followed this practice, although with some minor alterations it was kept up from March 13 until June 2. At this time I decided to do a left inguinal colostomy for the purpose of giving rest to the ulcerated sigmoid and rectum, as well as to admit of more positive local treatment.

Operation.—On opening the abdomen a surprising condition was revealed, the inferior mesenteric vein was very much enlarged and its walls thickened. All of its branches as far as they could be inspected were uniformly in the same strikingly swollen shape. Although I then realized that a colostomy would do little good the gut was fastened to the abdominal walls. After thinking the case over for a couple of days, I loosened the unopened gut and returned it into the abdomen.

Two months' further trial with local, dietetic and medicinal measures, there being no improvement, I opened the abdomen to determine whether or no there could be discovered in the pancreas or elsewhere along the route of the inferior mesenteric vein, an enlargement or interference by pressure on the vein near its entrance into the splenic vein. Nothing strikingly unusual was discovered about the pancreas except that it was thicker than normal and not quite so fixed. However, a considerably dilated stomach was found, and thinking this might, by dragging, possibly produce some interference or kinking in the circulation of the veins, a gastroplication was carried out after the manner of Moynihan. A Morrison operation was also done with the hope of relieving the portal system, and in this way lessening the congestion in the inferior mesenteric vein. My patient was much improved by these procedures; he gained in weight and his symptoms were better, but he was still an invalid. Two months later I established an artificial valvular fistula in the cecum for the purpose of complete, direct irrigation of the entire large bowel. Great improvement resulted from this last practice, the patient gaining 20 pounds during the next two months. There still was at that time some slight mucous discharge. I sent the man home, his many months' care at my hands having ended in a remarkably improved state. He was instructed to keep up the daily local treatment. A recent letter tells that he has allowed the fistula to close and that he is beginning to relapse. I have never seen such a uniform chronic enlargement of veins.

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When we recall the fact that the inferior mesenteric vein passes under the pancreas on its way to empty into the splenic vein, and the many pathologic, as well as congenital, alterations that may be found in the pancreas, possibly the observations made at the time of operation would be sufficient to account for the varix. From this point of view, reasoning from everyday experience in varicose ulcers of the lower extremities, the ulcerated bowel must be looked on as secondary to the varix of the inferior mesenteric vein. From the point of view, however, of the fact that veins carrying blood from chronically inflamed areas sometimes participate in the changes incident to the inflammatory process, we might reasonably conclude that the varix was in part the result of the long-continued prolapsus of the rectum, and the accompanying ulcerations of both the rectum and sigmoid, and probably of the descending colon also. All other veins in the abdomen were apparently normal. The only organs whose size and position were found abnormal were the stomach and pancreas.

During the past year I have had a case of chronic ulcerative colitis, which I have cured by means of an artificial valvular fistula in the cecum. In both cases I established an opening for a 30 F. catheter, in order that I might employ a reasonably good-sized flushing stream. The use of the open appendix as a channel for irrigation seems to me like using a toy pistol when an efficient firearm is essential. It is an unusually large appendix that can carry an 8 F. or 10 F. catheter, both too small for other than dribbling irrigation. I must acknowledge that some distinguished authorities have found this, the appendix channel, useful. In my cases I believe I did better by my patients in removing the appendix from each.

DISCUSSION.

DR. F. D. SMYTHE, Memphis, Tenn.—The custom has been recently adopted at the hospital where I am attending surgeon to refer the cases of chronic colitis entering the service promptly

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to the surgeon for operation and treatment for the reason that medical treatment heretofore has proven unsatisfactory. It was formerly our custom to resort to dilatation of the sphincter and irrigation of the colon followed by application of silver nitrate. Improvement usually followed such a course, but the patient soon relapsed, necessitating a repetition of the treatment, the patient almost always finally dying or drifting to another physician to undergo a similar treatment, with no better result.

Dr. Goltman, Memphis, at a meeting some months ago, detailed a course of treatment that he used for acute dysentery, the main feature of which was the dilatation of the sphincter under anesthesia, which treatment he asserts is sufficient in his hands. I have never employed this method.

The plan adopted by Dr. Summers in the treatment of his case is the same that I have employed for some time and with very gratifying results. I always make a good opening in order to introduce with ease a large tube for irrigation, paying no attention whatever to the appendix unless it is to effect its removal if time is not too much of a consideration. Such cases should be treated on surgical principles, thoroughly cleansed, rest of the part and attention to the diet. By such a course we have accomplished far more than was possible by medical treatment alone.

Dr. Samuel E. Milliken, Dallas, Texas.—Ulcerative colitis is one of our prevalent maladies. When Dr. Weir, New York, suggested last year at the session of the American Medical Association the use of the superfluous appendix as a means through which to reach the lower bowel, I was in hopes that I would have an opportunity of applying this method of treatment to some of our cases of ulcerative colitis, but up to the present time I have had no such opportunity. I have resorted to the various medicaments through the rectum and with varied and unsatisfactory results. I am glad to hear that there are better methods than those suggested by Dr. Weir. The methods suggested by Dr. Summers and the last speaker, i. e., the establishment of a fistula in the anterior wall of the cecum will possibly give more direct connection than the simple appendiceal method. I regret that an opportunity has not been afforded me to follow the suggestion, but it seems to me that this is a logical means of remedying what is with us a rather prevalent condition. Like the last speaker, I know nothing of the pathology which has led up to this condition.

Dr. John E. Summers, Jr., Omaha—I hoped that some one would say something about the anomalies of the pancreas or its changes in position. As the inferior mesenteric vein runs under the pancreas to empty into the splenic vein, which lies in a groove in the under surface of the pancreas, an obstruction in the return flow in the inferior mesenteric vein can be

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well imagined, provided there be an abnormality in the pancreas. I do not know what it was, but it seemed to me that, in this particular case, there was something unusual developed in the posterior area of the pancreas, and that this caused continuous interference with the current in the inferior mesenteric vein with the resultant varicosity. I merely mentioned the vermiform appendix as a route for the irrigation of the colon, as I had been impressed that Dr. Weir had advocated it as a kind of surgical joke. In the discussions of the surgical section of the New York Academy of Medicine, it will be noted that one or two surgeons have advocated this appendix route and have reported satisfactory results. One of these gentlemen stated that by dilatation one could succeed in getting the appendix to carry a No. 10 F. catheter. Everyone knows that such a caliber is too small for flushing purposes. When you want to flush out a cavity you must have a current and, therefore, I think a 30 F. catheter or 40 F. catheter none too large. You can remove the catheter, introducing it only when the bowel is to be irrigated. If the operation has been well done there will be no leakage.

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THE VALUE OF ENTEROSTOMY IN SELECTED CASES OF PERITONITIS.

F. B. LUND, M.D.
BOSTON.

Among the many serious aspects in which that protean disease, appendicitis, is presented to the surgeon, there is none more alarming than the types in which diffuse peritonitis is attended with intestinal paralysis and distention of the abdomen. Here we have in addition to the already severe septicemia due to absorption from the peritoneum, a toxemia from absorption of the poisonous products of stagnating feces in the intestine, and the great depression produced by gaseous distention of the bowel. The mechanical interference with the descent of the diaphragm renders respiration feeble and shallow, interferes with the aëration of the blood, and adds the grave complication of asphyxia to tax the failing strength of a patient already almost exhausted. It is hard to conceive of a more certainly fatal form of assault on the organism.

We all, as surgeons, are familiar with the insidious and dangerous character of those cases of appendicitis which are so often sent to our hospitals with a diagnosis of "intestinal obstruction"—cases in which with a normal or slightly elevated temperature and local signs perhaps indefinite, the great distention of the abdomen, the bright eyes, blue lips, and dry tongue tell the story of a diffuse peritonitis with intestinal paralysis, and warn us of the gravity of the case with which we have to deal.

It is in cases of this sort that we find the greatest diffi-

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culties in the operation, and must look most sharply for complications in the after-care, and it is to the treatment of cases of this type that I would briefly invite your attention. So dangerous seems to me this type of the disease that I can truly say that I would rather meet a case of diffuse peritonitis involving the whole abdominal cavity without paralytic distention of the bowel, than a more localized and dry form of the disease in which this complication is present.

A brief consideration of the nature and causation of this distention which we call paralytic is necessary to our further argument. This distention is a complex phenomenon in which several causes may reasonably play a part. In its production may be concerned: First, obstruction of the bowel by angulation, due to fresh fibrinous adhesions, and the prevention of peristalsis by these same adhesions when they involve an extended area of the bowel. Adhesions of this type are found early in the dry type of diffuse peritonitis.

A second causative factor may be the laming of the smooth muscular fibers by the infiltration of the intestinal wall with inflammatory products. In the early stages of appendicitis it is well recognized that the infiltration of the intestine in the region of the ileocecal valve may temporarily paralyze a local section of the bowel, and result in vomiting and distention which passes off as the disease subsides or is operated on.

A third causative factor may be the paresis of the musculo-nervous peristaltic apparatus by the effect of toxins absorbed by the central nervous system. The paresis resulting from this last cause may, for the purposes of our argument, be disregarded, as it will occur only in the latest stages of septicemia, and after our patient is reduced to the deepest stages of exhaustion by the absorption of toxic products.

In the cases in which distention comes on early in an attack, before the patient is profoundly septic, or soon after an operation, it is undoubtedly due to one of the

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first two causes, namely, adhesions from fresh fibrinous exudate, or paralysis of the musculo-nervous apparatus of peristalsis by the presence of exudate in the intestinal wall. Of these two causes, the first is probably the more important.

When we consider the complexity in the shape and position of the intestine, and the importance of free mobility both to the production of peristalsis and the prevention of obstruction, it seems remarkable that paresis and obstruction are not universal accompaniments of peritonitis. It is obvious that a central peritonitis, such as arises when the appendix or other infecting organ is centrally situated, among the freely movable coils of small intestine will be more apt to cause intestinal paresis than a peripheral process situated, for instance, on the outer side of the fixed ascending colon, and between the latter and the abdominal wall.

The greater comparative fixation and the greater caliber of the large intestine render it less liable to kinking from fresh fibrinous adhesions than the small intestine.

Distention due to the first cause, angulation or compression by adhesions, is more properly termed obstruction than paresis. Kinking many follow a local process, an adhesion at a single point, and result in distention of the entire intestine above that point. Multiple and extensive adhesions to other viscera and the abdominal wall may result in multiple angulations, and at the same time hamper the intestinal muscles, and these two processes may be associated in a greater or less degree with actual laming of the muscle itself by infiltration about and between the fibers. The exact part played by either process does not interest us, as the result is the same and the treatment indicated is the same, namely, to furnish a safe and easy exit to the contents of the over-distended bowel in order to allow it to collapse and recover its muscular tone.

In the milder cases it may be sufficient to stimulate peristalsis by irritating enemata of turpentine, glycerin

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and Epsom salts, and remove by the use of the rectal tube the obstruction from the contraction of the sphincter. These methods should be and are, of course, always tried before resorting to enterostomy. Enterostomy is a serious procedure; it subjects the patient certainly to the annoyance and discomfort of a fecal fistula, and generally to the danger of a secondary operation for the closure of the opening. The operation is, however, a simple one; it may be performed under local anesthesia, and the secondary operation is generally also simple and safe. It is proposed only in cases practically moribund from septicæmia, asphyxia, from pressure upon the diaphragm, and often continually vomiting feces. The rescue of a few of these patients who, if let alone, are face to face with certain death, is certainly an adequate recompense for the slight inconvenience of the operation and the fecal fistula. In these cases, then, after other means have failed, the operation, it seems to the writer, is distinctly indicated, and in his experience and that of his colleagues it has been the means of saving valuable lives.

Local anesthesia avoids the special danger of a general anesthetic in these cases, namely, depression and inhalation of vomitus.

A word as to the time for the operation. Certain surgeons, among them Dr. Mixter of Boston, advocate in cases of diffuse peritonitis with distention, the establishment of an outlet for gas and feces at the primary operation by the simple procedure of incising the cecum and tying in a glass tube. This tube may be removed in four or five days, after distention has been relieved and adhesions formed about the wound, and it is said that the fecal fistula rarely remains for so long a time as to require an operation.

The writer, however, has felt that a fecal fistula should not be established except as a last resort. He has had such good results from the free incision of the intestine and suture of the wound after emptying the bowel, and perhaps injecting a saturated solution of Epsom salts

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at the time, that he has deemed it wiser to limit the primary interference to the above-mentioned procedure, associated, of course, with drainage of the abdomen and the usual procedures for the treatment of the peritonitis. Enterostomy should, in his opinion, be reserved for those cases in which, after the primary operation, enemata have failed to move the bowels, and the patient's life is endangered by distention. Thus the patient is not subjected to the annoyance of a fecal fistula till other means have been tried, and both patient and operator are satisfied of its necessity.

This reasoning does not apply, however, to cases in which the operation is done on patients living at a distance who can not be under the surgeon's immediate personal care. Under these circumstances the writer believes it wiser to open the bowel at the primary operation rather than run the risk of the patient's dying from paralytic distention before he can reach him for the secondary procedure.

In a case of general peritonitis with distention operated on this winter in the country, the writer did not open the bowel at the primary operation and returned to the city. The attending physician was kept away during the night following the operation by an obstetric case, and could not open the bowel, and the patient died of extreme paralytic distention early in the morning of the day following the operation.

Under such circumstances, immediate ileostomy or cecostomy would be distinctly advisable.

Instead of opening the cecum the writer has opened the small intestine, for the following reasons:

1. The fibrinous adhesions which cause the obstruction are probably located in the region of the ileocecal valve, and affect the small intestine above that valve. It is manifestly important to open the bowel above the point of obstruction, therefore a coil of small intestine which by distention shows that it is above the main point of obstruction is chosen.

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2. The difficulty of the operation for resection and closure of a fecal fistula in the small intestine has, in the writer's hands, been considerably less than a similar operation on the cecum, because the small intestine can be brought outside the abdomen and operated on extraperitoneally, which is not always the case with the cecum. Lennander, who advocates opening the cecum at the primary operation or arranging gauze packing so as to have a surface of it exposed in the wound for subsequent incision, regards the opening of the small intestine as hazardous, owing to the uncertainty as to the distance of the point opened from the cecum. He has found in his experience that the coils of small intestine below the fistula become united by adhesions into a complex and undecipherable mass, and that if the patients lived, an ileocolostomy was necessary in order to cure the fecal fistula. The writer has not had this experience, although, as will be seen in the report of Case 3, an intestinal resection was necessary for chronic obstruction following enterostomy and closure of the fistula. This operation, however, was necessitated by adhesions above the ileocecal valve, so that it is difficult to see how opening the cecum would have relieved the obstruction in the first place, or how the fact that the ileum was opened had anything to do with their causation.

The advantages, then, of this method of ileostomy over cecostomy are that the intestine is certainly opened above the obstruction in case it is a kink in the cecal region, and the comparative simplicity of the operation for closure of the fistula. The bowel below the opening in the writer's cases never became so empty as to be adherent in a tangled mass, as shown by the fact that contents constantly passed through them, as shown by the abundant bowel movements. It is certainly a fair question whether the same result would not have happened had the cecum been opened instead of the ileum.

For the cecal operation the advantage is claimed that

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enemata, cathartic and nutritive, may be administered at once through the tube. The same treatment may be administered through a fistula into the small intestine. The primary point, it seems to the writer, is to get the intestine opened above the kinked or paralyzed portion, and enable the over-stretched muscles to get rid of their stagnating contents and recover their tone.

A word as to the technic: Local anesthesia with cocain solution (0.1 per cent.) should always be employed, owing to the danger of inhalation of fecal vomitus. The patient need not necessarily be removed from bed, but it is better to place an operating table in the room beside the bed, and gently lift the patient onto it. After cocainizing the skin and subcutaneous tissue, an incision one inch long is made in the median line below the umbilicus. The aponeurosis is then quickly infiltrated and the abdomen opened. The nearest distended coil of small intestine is sutured to the aponeurosis around the opening by a continuous suture of Pagenstecher thread, opened, and a large catheter or glass tube inserted a short distance into the afferent coil so as to prevent valve formation at the opening. An escape of a moderate amount of gas and perhaps feces takes place at once, and the patient generally expresses relief even for the slight diminution of distention which is at once evident. The operator need not be disappointed that the immediate amount of feces passed is small. A large gauze dressing is applied over the wound, which is kept separate from the other laparotomy dressing by a partition of rubber tissue stuck down to the abdominal wall with a strip of adhesive plaster.

In the course of a few hours, as the over-stretched intestinal muscles regain their tone, there follows a copious discharge from the opening, and generally the relief of tension allows the bowel below the opening to begin to act, so that enemata are successful in obtaining movements from the rectum. The pulse begins to fall within six to eight hours in successful cases.

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The operation for closure of the fecal fistula may be done at any time after the patient has recovered his strength so as to be in good condition for it. The technic is simple, and, as employed by the writer and his colleagues, is as follows: The opening is first closed by coarse silk sutures passed through its border in the abdominal wall. Then the opening is circumscribed by an incision through the skin and muscle close to the border, the abdomen opened, and the adhesions freed around the loop of the bowel. This is now drawn out of the abdomen and the margin of the opening with adherent skin, etc., excised till healthy bowel is reached. Then the opening in the bowel is sutured in a direction transverse to its axis (so as not to narrow the lumen) with through-and-through sutures of catgut. This line of suture is infolded by a continuous Cushing right-angled suture of Pagenstecher linen thread. The coil after being thoroughly cleansed with salt solution is then dropped back into the abdomen, and the wound in the abdominal wall closed with through-and-through sutures of silkworm gut around a small gauze drain passed down to the suture line.

In case the obstruction instead of being only temporary, has remained permanent, owing to persistence of the adhesions, further operative procedures, even perhaps resection of the intestine, may be necessary for its relief, as in Case 3.

A comparison of the value of the writer's method with primary cecostomy is difficult owing to the rarity of reported cases. He awaits the reports of cases in which that procedure has been adopted in order to estimate its immediate efficacy and favorable after-results, which, according to the verbal report of surgeons connected with the Massachusetts General Hospital, have followed that procedure.

Statistical comparison with secondary cecostomy is also impossible on account of the rarity of reports of cases. In certain cases, cecostomy has resulted in saving

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the life of a desperately sick patient,[1] and in these cases there can be no doubt that the distention was paralytic, or the obstruction, if present, concerned the sigmoid.

Cases 1 and 3 of this paper, however, may be pointed out as cases which would probably not have been helped by this method.

The writer has the privilege, through the courtesy of Dr. John C. Munro and Dr. George H. Monks, in whose service they occurred, of reporting three cases of enterostomy for intestinal paralysis following operations for appendicitis, and is able also to report one case in which the same operation was done for peritonitis following a stab wound in the intestine. Dr. John T. Bottomley has also, April 24, just performed the operation in a case seen in consultation by Dr. Munro and the writer, in a patient dying from distention forty-eight hours after an operation for acute appendicitis. The patient was temporarily relieved, but died on the sixth day after the operation of septicemia. The report of the case is kindly furnished by Dr. Bottomley.

In addition to these cases reported in full, the writer has done the operation in one other case of peritonitis due to the perforation of the vaginal vault by a splinter of wood; in this case the relief of the distention was not sufficient to enable the patient to overcome the advanced septicemia from which she was suffering, and she died.

He has twice opened the presenting intestine adherent in the bottom of a wound of operation for general peritonitis following appendicitis without avail, the patients being already septicemic.

The operation has also been performed twice by colleagues at the writer's suggestion in cases of distention in advanced peritonitis, in both cases proving unavailing.

The writer does not advocate the procedure with any hope that it will prove uniformly successful, because many patients who may seem suitable for it will be found

1. Madden: Lancet, London, 1902, 1533-34.

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to be suffering from septicemia so severe that they can not recover strength after relief is afforded to the distended bowel. He does not advocate it either in all cases of general peritonitis which are progressing to a fatal termination after an unavailing laparotomy. But he does feel that there is a class of cases in which the obstruction or paralysis kills the patient rather than the septicemia, and that of these cases a certain number can be saved.

REPORTS OF CASES.

Case 1 may be summarized as follows: Operation on the fourth day of a subacute attack of appendicitis. Appendix adherent at tip to rectum in median line. Secondary enterostomy under ether for distention and intestinal paralysis 48 hours after the primary operation. Recovery. Operation for closure of fecal fistula after six weeks. Recovery. Good health two years after operation.

History.—C. P. B., 21 years old, single, a bank clerk, was admitted to the City Hospital as a private patient of Dr. J. C. Munro March 20, 1901. The patient had had a similar attack two weeks ago. Was seized the day before entrance with griping pains in the abdomen, which gradually grew worse. Vomited twice last night. Pain is not continuous, but at times is very severe. Feeling as if of pressing down on rectum. Abdomen distended, everywhere tympanitic. No tenderness or spasm. Temperature 98. Pulse 80.

Operation.—March 23. Ether. Median incision. Appendix three inches long, inside and behind cecum, base adherent to iliac vessels, coiled spirally on itself and with tip bound in adhesions deep in Douglas' pouch Ligated close to base with catgut. Stump cauterized with carbolic acid. Adhesions in pelvis broken up to free adherent loops, and cavity drained with iodoform gauze and glass tube. Appendix showed gangrenous inner coat, nearly perforated one-half inch from tip at site of old stricture.

March 25.—No movement of bowels since operation. Glass tube removed yesterday. Slight discharge. Wicks removed to-day. Cavity well walled off. Abdomen distended and tympanitic. Pulse 140. Ether. Incision in left iliac region. A small quantity of viscid fluid. No adhesions. Marked distention of bowels. A loop of gut brought to wound and roughly sutured to the transversalis fascia, and opened, but only a small amount of gas or fecal fluid escaped on account of the distention. Another loop adjacent was sutured and opened in same way, but evacuations of gas were unsatisfactory. Both loops were apparently small gut, but later it was shown that one was probably sigmoid. The original wound was explored

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and found clean and walled off. On breaking up adhesions and freeing a loop probably of small gut that was adherent deep in the pelvis and at a sharp angle, there was an immediate gurgle as of pent-up gas. The original wound was drained with iodoform gauze around a glass tube and separate dressings applied to each wound. Patient in very poor condition, almost constant regurgitation, poor rapid pulse, cyanosis, etc.

March 26.—Pulse 120. At 10 p. m. basin full of feces drawn by a catheter through artificial anus.

March 27.—Pulse still lower. Bowels kept flat by passing catheter into artificial anus. Feeding by mouth resumed, as nutrients came out through artificial anus. Progress good. Profuse discharge through artificial anus.

On April 25, four weeks later, the writer closed the artificial anus as follows: Incision was made into the abdomen just clear of the adherent loops which were dissected free from the abdominal wall and separated from each other. The granulating edges of the bowel were excised, the openings in each loop of bowel closed in a direction transverse to the lumen of the gut by three rows of Cushing continuous fine silk sutures, and returned to the abdominal cavity after thorough washing. No shock from operation. Good ether recovery.

The patient made an excellent recovery from this operation, leaving the hospital, May 18, and is now, two and one-half years later, in excellent health.

Case 2.—Summary: Operation for acute appendicitis 24 hours after beginning of attack. Secondary enterostomy for intestinal paralysis 48 hours later under local anesthesia. Recovery. Closure of enterostomy four weeks later. Recovery. Good health one and one-half years later.

History.—W. B., 23 years old, salesman, was admitted to Dr. Munro's service at the Boston City Hospital on Nov. 21, 1901, 24 hours after the beginning of an attack of acute appendicitis. The abdomen was moderately distended and generally tender, the tenderness and rigidity being most marked in the region of the appendix. Temperature 100.2. Pulse 108.

Operation.—Dr. Munro operated on day of entrance by a muscle-splitting incision in the right iliac region. Abdomen full of serum and sero-purulent fluid, the purulent portion coming from the pelvis. A long, acutely inflamed appendix gangrenous in inner portion and hanging over brim of pelvis, was ligated with catgut and removed. As the general cavity was full of infected serum it was irrigated out with many quarts of salt solution and drained with a glass tube and iodoform gauze.

The following day he passed a little gas, but the pulse remained at 120 and the abdomen began to distend. The drain-

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age wicks were started. The pulse fell to 90. The next day in the morning the bowels moved, but without relief of the distention, which increased during the day, and the patient was given several high enemata of turpentine without result. The pulse rose to 142 and was of poor quality. The patient was nauseated and weak.

The writer, in Dr. Munro's absence, saw him at 9 p. m., and in view of the increasing distention and rising pulse decided to perform enterostomy. Owing to the patient's poor condition and the danger of fecal vomiting under a general anesthetic, local anesthesia with 0.2 per cent. cocain solution was employed. An incision 1¼ inchest long was made in the median line of the abdomen below the umbilicus, and the small intestine beneath was found injected and distended. A loop was sutured to the transversalis fascia by a continuous suture of Pagenstecher thread and opened, allowing escape of considerable gas and resulting in marked decrease of the distention. No shock attended the operation. Separate dressings were applied to the wound.

The following day the pulse fell to 112 and the distention was reduced by the passage of considerable gas through the artificial anus. Feces were soon passed by the rectum, but there was still abundant discharge from the wound until December 18, when Dr. Munro operated for closure of the fistula. The opening being closed by a temporary suture of silk, the incision was carried around the opening on each side through healthy tissue. There were no adhesions of the bowel except around the immediate edge, when it was sutured to the fascia. The loop of gut was brought out and the fistula excised. The opening was then closed by a row of Pagenstecher sutures, re-enforced by a Cushing right-angled continuous suture of pure silk. The wound was closed in layers with catgut and chromic gut.

Convalescence was normal, except for several attacks of vomiting and abdominal pain during the first week. The bowels moved freely and there was no distention. The patient left the hospital in good condition on Jan. 3, 1902. He is now, April 22, 1903, in excellent health.

Case 3.—Summary. Operation for acute appendicitis with distention on fourth day of attack. Secondary enterostomy 48 hours later for intestinal paralysis and distention. Closure of enterostomy three weeks later. Five weeks later resection of intestine for partial obstruction. Recovery. In good health at time of report six months later.

History.—J. W.. 11 years old, was admitted to the service of Dr. Monks at the Boston City Hospital on Oct. 28, 1902; four days before sudden pain in abdomen centering around umbilicus. Not radiating nor localized. Vomited frequently since onset of pain. No chills. Small movement re-

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sulting from enemata yesterday. General condition fair. Temperature normal. Pulse 100. Abdomen moderately and evenly distended. Coils visible. No peristalsis observed. Moderate general tenderness not at all localized. Moderate rigidity. Peritoneal facies.

Operation.—Ether. Median incision by the writer below umbilicus. Presenting intestine distended and injected. Free fluid, brownish and turbid. Incision enlarged to four inches, and intestine allowed to escape. Appendix found thickened, adherent, extending over pelvic brim into bottom of pelvis, where tip, covered with fibrin, lay in a small abscess cavity. Perforation ½ inch from end. Removal of appendix. At a point on the ileum near the ileocecal valve a large area of the surface of the bowel was covered with fibrin, evidently the seat of an adhesion. Below this point the bowel was not nearly so markedly distended as above. A coil of intestine above the adhesion was brought out over the side of the abdomen, opened and a large amount of feces allowed to escape. Saturated solution of Epsom salts was injected into the bowel and the opening sutured. Abdomen and pelvis flushed with salt solution. Bowel replaced and pelvis drained with glass tube and iodoform gauze wicks. Pulse 160 at close of operation.

October 29.—Occasional vomiting. Temperature normal. Pulse high and poor. Peritoneal facies, mildly delirious. No movement of the bowels or passage of gas.

October 30.—Abdomen considerably and evenly distended. Calomel, ¼ gr., every hour for eight hours without passage of gas. General condition worse.

Under cocain anesthesia an incision 1¼ inches long was made by the writer above the umbilicus. Presenting loop of small intestine, which was reddened and distended, sutured to transversalis fascia with silk. Small amount of gas and liquid feces escaped. Stimulated with strychnia, mildly delirious during operation. Not much relief from distention, probably due to atony.

October 31.—Good movement from turpentine enema. Now no distention.

November 4.—Profuse discharge from enterostomy wound and steady improvement.

November 7.—Attack of nausea and vomiting, with rise of pulse.

November 19.—One or two attacks of epigastric pain, nausea and vomiting.

November 21.—Ether and closure of enterostomy opening by the writer. Operation difficult on account of very extensive and firm adhesions to anterior abdominal wall. Separations of these adhesions difficult and attended by hemorrhage, which was controlled only by infolding the bleeding areas in silk. Opening in intestine carefully separated from abdom-

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inal wall and closed with Lembert sutures of fine silk. Further adhesions, very firm and fibrous, were noted to the lower part of incision, but it was not thought safe to separate them.

November 25.—Tendency to epigastric distention and occasional vomiting. Coils of intestine visible in epigastrium. Facies pinched. Occasional spasms of pain. Evidently partial obstruction. Operation discussed.

December 3.—Vomiting continual since last note. Distention continuing in spite of high turpentine enemata. Patient very restless. Facies pinched. Spasms of pain. Occasional passage of gas.

December 4.—Abdomen distended above umbilicus; coils visible.

Further Operation.—Dr. G. H. Monks. Ether. Incision in line of original incision below umbilicus. Abdomen opened freely. Great number of adhesions between intestines and peritoneum and between coils of intestine separated with difficulty, leaving large denuded areas of bowel which oozed freely and which could not be covered with peritoneum. At a number of places the adhesions had contracted the bowel, but not enough to reduce the lumen so as to endanger the fecal current. On following the jejunum toward the iliac fossa a marked contraction, cicatricial in character, was found, complicated by adherent omentum and bowel. The intestine beyond was collapsed; proximal intestine moderately distended. Adhesions were separated. The constricted portion of bowel was excised by removing a wedge-shaped segment 2 inches long on free border and one-half inch long on mesenteric border. Suture with continuous right-angled Cushing suture of fine silk. Patient's condition had become precarious, so that no effort could be made to stop oozing from denuded peritoneal surfaces or to correct other partial constrictions which were found. The abdominal cavity was irrigated with salt solution and the wound hastily closed with interrupted silkworm gut. Small iodoform wick to seat of anastomosis. Rallied slowly from ether and operation.

December 5.—Slight delirium. Still distention. Pulse 140.

December 9.—Pulse 100. Vomiting ceased three days ago. General condition much improved. Distention disappeared. Abdomen soft. Good results from enemata.

December 14.—Rapidly improving. Soft solids by mouth.

December 28.—Gradually gaining. Diarrhea for past three or four days.

January 4.—Improving rapidly, though still much emaciated and pale. Diarrhea still. No distention.

January 9.—Still four or five liquid movements a day. Slowly gaining strength. Up and walking by aid of chair. He left the hospital on this date and reported on April 15, 1903, in excellent condition, having fully recovered his health and strength.

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CASE 4.—Stab wound of small intestine. Suture of wound and return of intestine followed by properitoneal hernia. Operation for hernia followed by peritonitis with distention and adhesion of a coil of intestine to operation wound. Enterostomy on an apparently dying patient followed by rapid recovery. Closure of fecal fistula six weeks later.

History.—D. M., 62 years of age, was admitted to the Quincy Hospital Feb. 2, 1903, to the service of Dr. N. S. Hunting, through whose courtesy the writer is permitted to report this case. While at a dance at 1:30 a. m. the patient was stabbed in the abdomen. He walked to the office of a physician, who probed and sewed it with catgut. Pain followed and he was admitted to the hospital at 3:30 a. m.

Operation.—He presented a crescentic wound ⅝ in. long one-half inch above and to outside of spine of right pubes. Three stitches were removed. Abdominal wall thin and bowel presenting. Drs. Hunting and Ellsworth operated. Wound enlarged and opened parallel to rectus. It was found that the muscles had been cut upward and outward parallel to and just above inguinal canal. Some free bleeding from cut edge. Punctured wound of ileum ⅛ in. long, from which yellow serum-like fluid exuded on pressure. Closed with two rows of silk suture. Inguinal canal closed with kangaroo tendon after washing out with salt solution. The patient did well for three days, then, on February 11, there was abdominal pain and obstruction which high enemata failed to relieve. Temperature normal. Pulse 60.

Second Operation.—Ether. Dr. Hunting operated. Wound enlarged and opened parallel to rectus. Bowel at site of injury in good condition. Wound tight. On further examination it was found that the peritoneum was deflected from level of anterior superior spine and 19 inches of bowel lay outside the peritoneum, i. e., a peritoneal hernia. Opening in peritoneum was constricting the gut. It would admit tip of finger. Peritoneum opened freely and bowel inside was found injected with flakes of fibrin. The bowel was replaced and cavity washed with salt solution. Peritoneum and wound sutured around a drain of iodoform gauze.

During next three days cathartics and enemata failed to induce movement of bowels.

February 17.—Abdomen distended, skin red, pulled apart.

February 18.—Pain and tenderness in right abdomen.

February 19.—Distention. Wound looks sluggish. Slough and purulent expectoration.

February 21.—Condition same. Distention very marked in spite of repeated small movements from $MgSO_4$. Regurgitates dark green fluid.

February 22.—Uncomfortable. Pulse and temperature good.

February 23 the distention became extreme. The patient

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was continually vomiting fecal matter and the pulse rose to 140 and became very weak. The writer was called in consultation and found the patient in very poor condition. It was decided to perform enterostomy. With local anesthesia an incision one inch long was made in the median line below the umbilicus. On opening the abdomen it was found full of pus. It was thought desirable to supply drainage for this pus before opening the intestine, and the writer therefore decided to reopen the original wound and insert a glass drainage tube through its lower angle into the pelvis before performing the enterostomy. On dissecting into this wound the intestine was accidentally opened and at once there took place a very free passage of gas and feces, and the patient expressed himself as relieved. The intestine was therefore sutured to the abdominal wall at the place where it had been opened and the other wound was abandoned. A third incision was made in the median line just above the pubes into the abdomen, and through this a drainage tube was passed into the pelvis and the pus washed out of the peritoneal cavity with salt solution. All these procedures were performed without difficulty under local anesthesia. After the operation the patient's pulse and temperature steadily fell. For the first few days feces were discharged through the artificial anus. Later he began to have movements of the bowels. The irritation of the skin of the abdominal wall by the escaping intestinal fluids was a source of considerable annoyance. The patient improved, however, and on April 18 the writer performed the operation for closure of the fecal fistula as described in the three preceding cases. At the time of writing, April 22, the patient was having a most satisfactory convalescence.

CASE 5.—*History.*—R. R., 25, single, was recently operated on by Dr. John T. Bottomley, at the Boston City Hospital, on the third day of appendicitis. He found the appendix acutely inflamed, adherent to pelvic brim, free pus in the abdomen and fibrin flakes on the neighboring intestines. There were two perforations near the tip of the appendix. After excision of the appendix the wound was packed and drained freely with iodoform gauze. The abdomen was washed with salt solution. Cultures from the pus showed *Staphylococcus albus and Bacillus coli communis.*

The patient made a good recovery from ether, but for two days after the operation no gas or feces passed the bowels. The pulse gradually rose, and on the morning of the third day the patient began to vomit and vomited dark brown material frequently. The abdomen was distended. The pulse was 140 and he was very weak, cyanotic and evidently desperately ill. He was seen by the writer and Dr. Munro in consultation. Dr. Bottomley performed enterostomy under local cocain anesthesia, making a median incision through the abdominal

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wall below the umbilicus. On opening the abdomen the intestine was injected, but there was no excess of fluid in the cavity. A loop of intestine which presented under the wound was sutured to the aponeurosis of the rectus muscles by continuous silk sutures and opened. There was an immediate discharge of gas and feces. A bent glass tube was tied in to the intestine attached to a rubber tube which went over the side of the bed. Soon after the operation the patient stopped vomiting and was able to take liquids by the mouth. During the next three days his condition gradually improved. There was copious discharge of feces through the enterostomy wound. The bowels moved by the rectum under the influence of enemata. On the fourth day, however, the abdomen began to distend in spite of the movements of the bowels, and the pulse to rise. On the fifth day the patient began to vomit, and died on the morning of the sixth day.

In this case, it is evident that the operation did not save life, but its effect in relieving the patient was marked. He was moribund at the time when the operation was done, and the improvement which took place seemed almost miraculous. Hopes were entertained of his recovery. There is no question that he died of continued peritoneal infection, which in itself is sufficient to kill many patients even without obstruction of the bowels. No one regretted having made the attempt to save him by enterostomy, for it was felt by all concerned that everything had been done to save the man's life. At a partial autopsy it was found that the opening in the intestine was just 8 inches above the ileocecal valve.

SUMMARY.

Enterostomy is indicated for obstruction or paralytic distention of the intestine from whatever cause, after the ordinary means for relief of such distention have failed. It is especially applicable for distention after operations for acute appendicitis or general peritonitis. Under such circumstances it may restore to life cases in which death seems inevitable. Secondary ileostomy is the operation of choice. Local anesthesia is to be preferred. The subsequent operation for closure of the fecal fistula is usually safe and successful.

DISCUSSION.

DR. M. B. TINKER, Baltimore—Enterostomy has been used in selected cases of this kind at the Johns Hopkins Hospital for the past five or six years. It was introduced there by Dr. Finney, but has been used only in a few cases, for the reasons

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given by Dr. Lund. It is very repulsive to the patient to have a fecal fistula; the skin is usually excoriated around the fistula, frequently causing severe pain, and it is very difficult to keep the patient clean. In the last three years I have not seen secondary operation necessary for the closure of fecal fistula, however. The intestine should be brought up to the abdominal wall and sutured; a tangential enterostomy which does not bring the gut outside of the abdominal cavity, as in colostomy. Some operators have made a mistake in bringing the gut outside of the abdomen, thus making a secondary operation always necessary. When the fistula persists, as it frequently does, for weeks, excoriation of the skin is a source of great discomfort, and the patients can be greatly relieved by putting them in a tub of warm water. Cases in which enterostomy is of great value are the cases of obstruction following perforation with localized peritonitis. To break up the adhesions and relieve the obstruction would mean the soiling of the entire peritoneal cavity. By the enterostomy we relieve the obstruction at once, and in most cases the obstruction coming from distention gives no further trouble after this is relieved. Leaving an enterostomy opening, instead of closing perforations in the intestines also saves lives in many cases. Dr. Follis did this in a case of typhoid perforation in which the patient was in an extremely low condition, and the very least intervention seemed indicated. This can be done much more quickly than suture of the perforation, and in the case mentioned the patient made an excellent recovery, in spite of his bad condition at the time of operation. In a case of gunshot wound of the abdomen with eleven intestinal perforations, the patient was brought into the hospital in a very low condition with the abdomen full of blood. Extensive intervention meant death, and instead of attempting to suture all the openings, a loop of intestine with four perforations in it was resected, the ends brought out to form enterostomy openings, and was gauze-packed about. Recovery followed in this case also. While not to be advocated in all cases, the use of this procedure in certain critical cases of obstruction from peritonitis has, I believe, saved a number who would have died from a more extensive operation.

Dr. Miles F. Porter, Fort Wayne, Ind.—Some years ago I had the honor of reading a paper before the Mississippi Valley Medical Association, in Detroit, in which this subject was referred to, and a year or two afterward, 1897, I read another paper on the subject of tympany. I tried to show in those papers that there were many cases of peritonitis that died that might and would have recovered had that one symptom been overcome. This statement I had at that time been convinced was correct by at least one case, and since then I have seen

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it corroborated in a number of cases. I have seen cases of peritonitis with enormous quantities of pus, in which the patient was in such a deplorable condition from the tympany that I felt warranted in relieving the tympany by opening the gut before I drained the abscess, and I have had the satisfaction of seeing at least one of these cases get well.[1]

The point that I wish particularly to emphasize is that many of these patients die because of the tympany, and if that is relieved the patient will get well, or so far recover as to enable one to perform an operation later to remove the original cause of the peritonitis.

Now, in regard to the occurrence of fecal fistula, I wish to emphasize a point made by the last speaker. The fistula will not need to be closed by the surgeon, if it is properly made to start with. If the gut is simply attached to the peritoneum, it will close itself and render a subsequent operation unnecessary.

Dr. C. P. Thomas, Spokane, Wash.—It appears to me that we—particularly the last speaker—are getting the cart before the horse. If we simply attach the bowel to the abdominal wall and make an incision in it, disregarding the pathology, we will get left in a great many cases. I do not believe one case in a hundred of fulminating appendicitis, for instance, where we always have intestinal paralysis, would get well if we simply did an enterostomy.

If we will first remove the cause of the intestinal paralysis, it will not often be necessary to attach the bowel to the abdominal wall and open it. After most intraperitoneal operations there follows some peritonitis, with obstructive symptoms; the time at which we can safely say a given case will recover, or not, without enterostomy, is not to me a definite one, and I believe the cases that recover with enterostomy would have done so without it. The half dozen cases that I have operated on, died, while others apparently as bad recovered without operation. I heard Professor Nicholas Senn once say that his experience had been the same.

We should not expect intestinal drainage to cure peritonitis, but should first remove the cause, leaving enterostomy as a last resort. High rectal injections of alum solution will often hasten normal bowel movement.

Dr. James B. Bullitt, Louisville, Ky.—I think we have gotten the cart before the horse, or at least the last speaker has, as I think there was no question raised by the essayists regarding the cure of appendicitis by making an enterostomy. The conception of the author evidently was that the cases of appendicitis should be dealt with in the best possible manner, and when, after the operations have been performed, the con-

1. Medical News, July 31, 1897.

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dition of the patient demands it, that this operation be done. I believe that all of us, who have not grown very old, perhaps, have been confronted by the most depressing problems. The patient that apparently should be getting well develops a tympany, and the surgeon is always undecided whether or not this tympany will be overcome in the particular case, or whether, if the tympany be unrelieved, the patient will be carried beyond the reach of the surgeon, and death result. Under these circumstances, I say that the younger members of the profession find themselves in the greatest embarrassment, and the older members of the profession, perhaps, are not prone to give them the greatest amount of comfort. Under these circumstances the operation as outlined by the author would seem to me to be the most rational form of procedure. It is one with which good surgeons have been familiar for many years. I am sure that in many cases it is the best and most conservative operation to do, as we can never tell just when these patients have passed the danger line, and if we do not do it, we have to trust to luck that the patient will pass safely by the probabilities of death on the next day.

Dr. F. A. Dunsmoor, Minneapolis—I thought when the essayist was reading his paper that I would have given much at his age to know what he does now, because I am sure we hear of many cases being relieved by this measure. I am sure the essayist doesn't mean to convey to any of the pessimistic men who wish to criticise him, that the operation will cure every person who has intestinal paralysis, obstruction, or who has infection, whether following an operation or a primary condition. It certainly is an important thing to recognize that there is an opportunity of preventing death following postoperative obstruction in this region. When we have made out the fact that our patient has been badly poisoned, either because of the pus previously present, or from operative infection, either obstructive or septic, then we know that something else has taken place within the intestinal tract beside digestion, and we also know that there is a large amount of toxic material there which is going to do harm. It can not get out if there is obstruction or paralysis of the bowel, and we should do as much as possible for relief with as little manipulation as possible, and not hunt all around the abdomen for the perforation. I believe patients have been killed by attempts of surgeons to relieve the condition by suturing the perforation, the local poison being distributed to the general peritoneal cavity with overwhelming results. I open the gut, empty and wash it out, if possible, by means of the normal saline solution. I have not had the opportunity of trying the alum solution, but I am sure that I have seen cases cured, not only by the alum method, but by making a tempo-

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rary window in the gut at the time, and doing a subsequent operation for relief of conditions present.

DR. FRED B. LUND, Boston—In regard to the fistulas, I would rather close them than wait for Nature, and I think the patients would rather have this done. I do not advocate enterostomy in all cases of peritonitis, nor do I claim it is an unfailing cure. I expressly stated the fact that all other intestinal measures should be employed first, before this operation is undertaken.

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CONGENITAL DISLOCATIONS OF THE RADIUS.

CHARLES A. POWERS, A.M., M.D.
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DENVER.

History.—In November, 1902, X. Z., a boy of 13 years, was brought to my office. Three days after his birth disability and deformity were noticed at the left elbow and in the left hand. In early life the general use of the limb was practically the same as at present. As years have gone by the limb has become neither more nor less useful.

Examination.—The left upper extremity is materially shorter than its fellow. The left forearm is in extreme pronation; it can be supinated but very little, the lower end of the radius moving but slightly on the ulna. As the limb hangs by the side the back of the hand looks forward and inward. If the boy is asked to flex the elbow he does it by abducting the arm to 45 degrees and throwing it forcibly forward. With the hand on the abdomen and chest he can then flex the elbow to 90 degrees, but not further. Flexion of the fingers is fairly good; extension is weak and imperfect. The thumb is flexed and adducted in the palm of the extended hand, being rotated somewhat out. Flexion of the fingers is made over this palmar-flexed thumb. When offered a coin the boy lifts the arm, rotates it in and throws the palm of the hand inward, then outward and forward to receive it. He makes no ordinary gestures in attempting to receive proffered articles. He uses the affected hand but little.

The elongated left radius is dislocated upward, forward and outward, lying on the outer and anterior aspect of the humerus. The condition is shown in the accompanying *x*-ray picture and in the photographs. Measurements are as follows:

Circumference of the right arm at its middle, 7½ in.; of the left arm at its middle, 6½ in. Circumference of the right forearm 2½ inches below the elbow is 7½ in.; at the same point on the opposite side it is 6 in. The right upper extremity from the tip of the acromion to the tip of the middle finger is

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25 in. long; on the left or affected side it is 20½ in. long. With the elbow flexed the right arm measures 11½ in. from the tip of the acromion to the olecranon, on the opposite side it measures 10½ in. The right ulna is 8¼ in. long, the left ulna has a length of 6¾ in. The cup-shaped upper surface of the radial head is plainly felt, some 1⅛ in. above its normal. It can be satisfactorily palpated. It seems to be of normal size. It rests anteriorly on the external humeral ridge. The bones below seem to be normal in shape. Innervation of the extremity is good.

The boy is otherwise normal; his mental condition is excellent. His general appearance is that of boys of his age.

The boy was brought with a view to determining whether he would be apt to be helped by an operation. At first thought I felt that resection of the upper end of the radius would permit freer motion. However, on considering that the condition was due to defective construction, that the entire limb was imperfect and that the hand was deformed as well as the elbow, it seemed probable that any operative procedure would be tentative. The parents declined operation unless given a fairly positive assurance.

So few cases of this affection have been observed and reported that one is destitute of data on which to form an opinion as to the value of operation. Thus, while various observers have noted the pathologic condition postmortem or have described the symptoms in living cases, I am unable to find but three instances in which recourse was had to operation. (*Vide infra* for question as to the authenticity of the second of these.)

Langenbeck in 1865 made a simple resection of the entire left elbow of a 6-year-old patient of Mitscherlich.[10] No result was observed, as the child died some weeks after operation.

Bessel-Hagen[20] made a simple resection of the head of the radius with the best result.

He found the form of the radial head altered, almost spherical and smooth. The cartilaginous covering had disappeared in many places. The dislocated and badly deformed annular ligament covered the most external

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end of the bone like a distorted cap, partly bound to it by fibrous strings. Bessel-Hagen did not anticipate a successful result, and resorted to operation only after much persuasion. But happily after the operation the formerly half-flexed arm could be stretched out perfectly. Through methodical, energetic movements full supination was soon possible. Over a year after the operation the girl could perfectly stretch and bend and supinate and pronate the arm. The bones slid easily and smoothly on each other, the sensitiveness had disappeared and strength for work was increased.

Bonnenberg[25] reports a case referred to him by Hoffa. I cite this at length as it is fully described by the author. The result is seen to be one of but moderate improvement. Further, the type of the affection approaches that observed by me.

The patient was a girl of 20 years. The right radius was dislocated forward. The right arm appeared shorter and weaker than the left, especially in the forearm. The forearm was in position of supination, the hand being dorsally flexed. While the radius approached the normal, the ulna was twisted in its lower part and in the upper and middle thirds was more convex than normal. The elbow joint could only be extended to an angle of 155 degrees. In the extended position was clearly felt the epicond. internus humeri, the point of the olecranon and the epicond. externus humeri. If the arm was flexed the head of the radius glided up on the anterior surface of the humerus. Pronation of the hand was not possible. The patient had worn apparatus which held the head of the radius firm, but its weight and pressure were annoying, and since an improvement through its use could be looked for only after a very long time the patient preferred operation, which was performed by Bonnenberg and Hoffa.

An incision about 6 cm. long was made on the outside of the elbow joint over the external condyle of the humerus, parallel with the long axis of the arm. The

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joint capsule was opened. The entire outer half of the lower end of the humerus was slightly concave, so that no clear limit existed between the eminentia capitata and the part of the epiphysis not covered with cartilage. The cartilaginous covering of the eminentia capitata reached

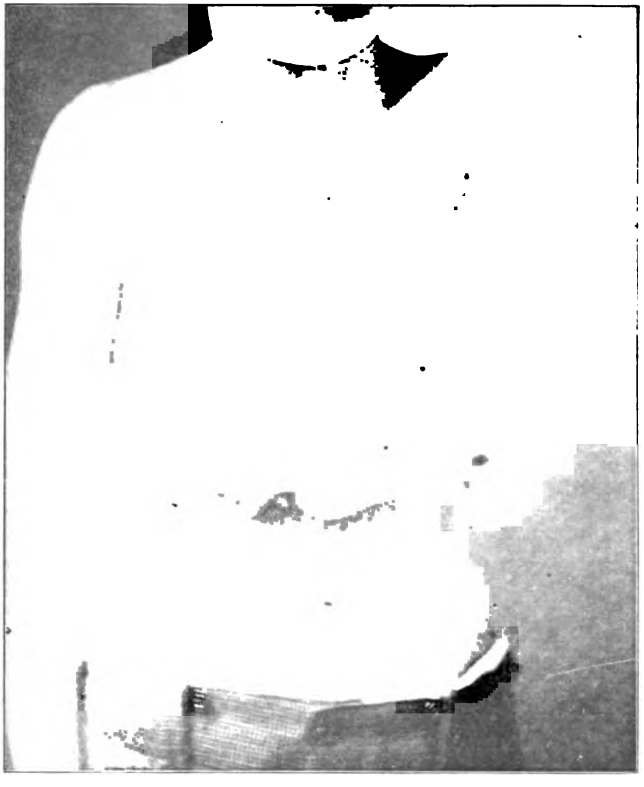

Figure 1.

about 2 cm. higher than normal. The outer edge of the lower end of the humerus appeared much thinned. In the curved lower part of the humerus the head of the radius lay over the eminentia capitata. It was completely covered with a fibrous capsule which was attached about the neck and was connected with the outer part

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of the joint. The capsule was split over the head, and after the periosteum was loosened a piece of the radius about 3 cm. in length was taken off, the cut surface smoothed and the radius passed under the eminentia capitata of the humerus. The capsule which covered the head of the radius was taken away. Flexion and extension of the elbow joint were now entirely unhindered.

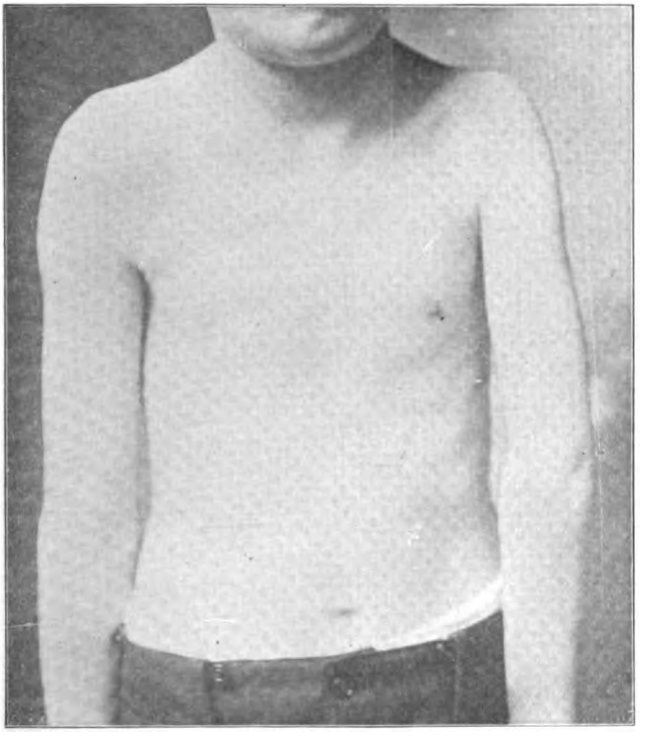

Figure 2.

Not so, however, with pronation and supination. Therefore an incision about 4 cm. long was made over the styloid process of the ulna and after loosening up the periosteum a piece about 3.5 cm. long was taken from the lower end of this bone. Then pronation and supination were possible. Healing by granulation took place

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in about a month, when movements were begun. The arm was massaged daily. Electrical treatment. A little later, since there was still present the spiral twisting of the radius, osteotomy was performed between the middle and lower thirds. Again healing by granulation. When

Figure 3.

this was complete systematic attention to movement was given. At the end of a few months the condition was as follows:

The radius ends over the external condyle of the elbow; there is decided weakness of the right arm as

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compared with the left. Measurements: Right middle upper arm, 22 cm.; left middle upper arm, 26.5 cm.; thickest part of forearm, right, 20 cm.; left, 23 cm.

Voluntary pronation and supination are not possible on the affected side. The case may be said to be moderately improved. The piece that was taken from the upper end of the radius was 3 cm. long; the diameter at the head, 15 mm.; at the neck, 13 mm. Demarcation

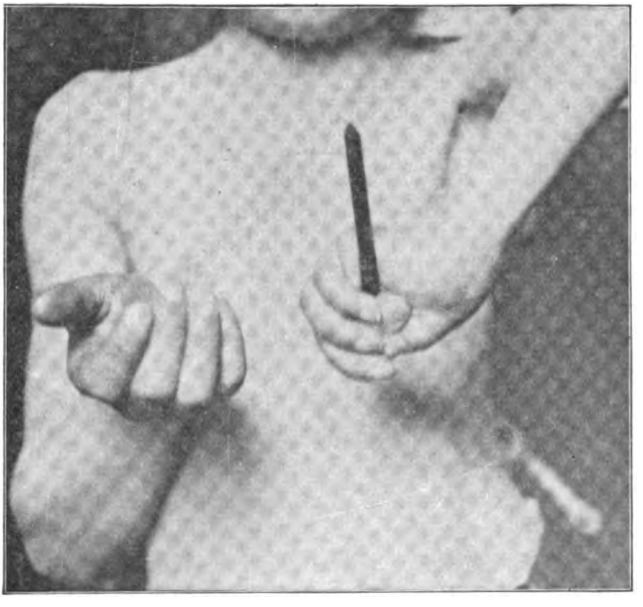

Fig. 4.—Showing the position of the limb when the patient attempts to receive a proffered object.

between the two was scarcely present. The head was defectively developed; it was infantile; it was lacking in cartilaginous covering except at a place on its posterior circumference about 1 cm. in diameter. Here the head of the radius glided over the anterior surface of the humerus. A characteristic glenoid cavity was not present. Good pictures show the condition before and after operation.

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Bonnenberg[25] collected 30 cases in 1893; of these 12 were double, 18 were single. Since that time the only observers of whom I can find record are Ambard,[22] Abbott[21] and Bergtold.[19] Ambard reported a double luxation in a man of 28 years who applied for treatment for excoriations of the external aspect of each elbow. Two very prominent protuberances on the outer part of each elbow were noted, which were brought into action by the different movements of the forearm. On looking at the posterior surface all of the middle and internal part appeared normal. But at the external view there was a prominence rounded over its lateral surface, flattened at its superior extremity. From in front the region of the elbow appeared normal. On palpation this bony prominence could only be considered as the upper extremity of the radius itself. In supination and pronation the radial cup could be rolled between the fingers; in flexion or extension it was lowered or raised. In spite of the abnormal situation the superior extremity of the radius was strongly connected with the other bones of the joint. All of the ordinary movements of the elbow, as well as the muscular force, were perfectly preserved. The length of each radius was 1 cm. more than that of the ulna, whereas normally the radius is 0.75 cm. shorter than the ulna. The ulna and humerus were normal. The two dislocations were absolutely symmetrical. The rest of the skeleton was normal, save that the two clavicles were prominent at the middle part. The nose was sunken in on account of caries of its bones and atrophy of the inferior turbinate; there were various ocular lesions pointing to hereditary syphilis.

The dislocations of the radii were noticed soon after birth. There was no family history of the trouble. The writer is inclined to think this patient a hereditary syphilitic, and thinks it possible (?) that the deformity was due to this trouble. Excellent radiographs are given.

Bergtold[19] gives an admirable account of a similar

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case, except that while flexion and extension were perfectly preserved the forearms were in extreme and fixed pronation. Abbott[22] reports on 9 cases, 7 of which occurred in one family, the cases having been scattered over four generations; 5 of the cases belonging to three generations had been examined personally by him, and all presented dislocation of the radius forward in one or both arms. Flexion and extension in all were free, but there was no movement of pronation or supination. In all the cases the deformity had caused the patient much inconvenience; no member of the family was the subject of any other deformity. Dissections of the elbows of the youngest of these cases were shown by Abbott at a meeting of the London Pathological Society, the chief abnormality in one being a large protuberance from the outer side of the coronoid process, fixed to the neck of the radius and possessing an extra center of ossification. The dissected elbows of a child of two months were shown. On the right side there was a dislocation of both bones directly backward, the articular end of the humerus being deeply cleft and much altered in shape. On the left side the radius was dislocated backward, upward and inward, still keeping its normal relation to the ulna which articulated with a mass of cartilage attached to the lower part of the shaft of the humerus, representing the trochlea and internal condyle, the lower end of the humerus consisting only of external condyle and capitellum. In this case the prime trouble was evidently in the humerus. A living example of congenital dislocation of the left radius backward and outward in a girl of 21 years was also shown. The president of the society, Sir George Humphrey, thought that in all cases the displacement was slight, and that all seemed to be due to want of proper condition of the orbicular ligament. (There is a similar case in the Cambridge Museum in which both humerus and radius are deformed, the neck of the latter being longer than it should be, thus causing difficulty in flexing the forearm.)

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In a further discussion of these cases Abbott says that in all the deformity was first noticed when the child began to use its hands, and in no member of the family was any other deformity present. This tendency has twice been transmitted by males, twice by females, while in only one instance has the person transmitting it been herself the subject of the lesion. In one case it has occurred in the third generation, both father and grandfather transmitting the tendency without being affected, and the affection of the grandfather's brother pointing to the deformity having existed one generation earlier still. Abbott states that among cases of congenital dislocation of the radius that have been previously described he has been able to find but one in which the deformity was hereditary. This was the case of Pye-Smith.[16]

It is plain that only those cases can be accepted which (*a*) have been observed by a physician directly after birth, or (*b*) which are hereditary, or (*c*) which coexist with other deformities. If this test be applied it throws out such cases as that of Bessel-Hagen.

Herskovits[18] deduces as hypotheses to explain these luxations: 1. External injuries to the belly of the mother (Cruveilhier) or muscular activity of the fetus (Chaussier). 2. Disease of the capsule or the ligaments (Sedillot), hydrops or fungus (Parise, V. Ammon). 3. Disease in the central nervous system, with consecutive contractures (Guerin) or muscular paralysis (Verneuil). 4. Peculiar fixation of the limbs *in utero* (Dupuytren). 5. Defective construction of the joint (Paletta, Breschet, V. Ammon).

Appraillé[24] has written an exhaustive monograph on congenital malformations of the upper extremity of the radius. His cases are of congenital absence or defective development of the bone rather than of dislocation. From the functional point of view, however, they also are characterized especially by absence of the movements of pronation and supination of the forearm. He believes them to be the result of quite extensive amniotic compression occurring before the formation of the skeleton.

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DISCUSSION.

DR. JOHN T. BOTTOMLEY, Boston—My personal experience with congenital deformities of the radius has been absolutely *nil*. I have here two reports of cases from Dr. F. J. Cotton of the out-patient department of the Boston City Hospital, which I will read. The luxations were similar, though not congenital:

CASE 1.—*Syphilis of the elbow, congenital.*—M. R., aged 15, doubtful specific history. Three years ago trouble in the left elbow. She was first seen two years ago, at which time there was backward luxation of the radius, bony cartilaginous masses at the lower end of humerus, the radial head and the ulna. There was much loss of motion, especially of supination, of which there was none. There was not much pain and no spasm. Operation refused. She was treated with potassium iodid for two or three months and then lost sight of. About a month ago she was looked up, and I found the motion slightly improved, but the masses are unchanged.

CASE 2.—B. H., aged 17. For two years she has had trouble with the elbow, which has not been painful, but has caused much limitation of motion. Congenital specific history.

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At the present time is under treatment for iritis. Her condition was almost exactly like Case 1, but with dislocation of the radii at both elbows. She was operated on in December last, at which time there was excision of the heads of both radii with transplantation of the distorted orbicular ligament to original site. Early mobilization followed, and she was treated with potassium iodid. Ether was administered once in order to free adhesions. Excellent results followed, and all motions are now practically normal on one side; much improved and still improving on the other side, but supination is not free. Both cases were what is described as false tumor albus. The radial luxation results from the thrust of the raw cartilaginous formation. There is no synovial disease.

Dr. Fred. B. Lund, Boston—I have seen the cases reported by Dr. Cotton, and the result he has obtained in one arm is certainly remarkable. The motion is not perfect, but it is a material improvement, and it is certainly a revelation to see what that operation has done.

Dr. De Forest Willard, Philadelphia—I have seen two or three cases of congenital dislocation of the head of the radius and a number of cases where there have been various congenital defects of this region. When the humerus or the radius are affected the hand is usually carried in the position of extreme pronation. I do not think that any law can be laid down in regard to operation in these cases; every case must be studied according to the conditions presented, and from the standpoint of the type of distortion. In a case presenting the symptoms described by Dr. Powers, the chances are decidedly in favor of a gain by excision of the radius, together with section of the muscles to relieve the extreme pronation. In congenital and birth palsies from injury of the brachial plexus we nearly always have this same pronation. It may be relieved by cutting off the flexor and pronator muscles from their attachment to the humerus and ulna. The arm can subsequently be used 5, 10 or 15 per cent. better, while the improvement in the appearance is 30 to 40 per cent.

Dr. Charles A. Powers, Denver—One's first thought in such a case as this would be to take out the head of the radius. The parents refused to have this done unless given positive assurance that definite benefit would result. In view of the associated conditions and after a careful study of the literature on the subject I did not feel that I could give them this assurance. I believe that Willard's suggestion of dividing the internal rotators of the humerus to be a very useful one. I should be obliged to carefully study the histories of the cases cited by Dr. Bottomley before being certain that they were analogous to the one which I present.

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ACUTE EPIPHYSITIS CAUSING A CONDITION SUBSEQUENTLY SIMULATING CONGENITAL HIP MISPLACEMENT.

JOHN PRENTISS LORD, M.D.
Professor of Surgery Creighton Medical College; Attending Surgeon St. Joseph's Hospital.
OMAHA.

The writer uses the word misplacement, instead of dislocation, agreeing with Tubby, who says that dislocation can not properly be applied to a condition where the bone never was in place; the word misplacement seems to be better suited to describe the congenital condition. Epiphysitis does, however, result in a dislocation, and the condition might therefore be properly called pathologic dislocation of the hip, resulting from epiphysitis.

May 12, 1902, a female child of 2 years was referred to me by Dr. McClanahan. It was delicate, but well nourished. Appearances indicated congenital misplacement of the right hip. Indeed, all the conditions were typical of this condition. The history, however, disclosed information which placed such a diagnosis in doubt. At 16 months, when the child had essayed to walk, she was normal, as far as the parents knew. At this time she suffered a severe attack of lobar pneumonia, from which she was convalescing when she had an abscess over the hip, which was incised. Resolution was speedy, and no trace was left on examination save a small scar one line in width and two lines in length, situated 3 cm. below and 1 cm. internal to the anterior superior spine. This history following pneumonia indicated that the abscess was pneumonococcic. The history elicited from the attending physicians gave evidence of so speedy a resolution that articular or epiphyseal disease could scarcely be credited, though it was suspected. A periarticular suppuration predisposed by a misplaced hip, excited by the pneumonococcus, was thought to be a possibility. The history gave no certainty as to the diagnosis of

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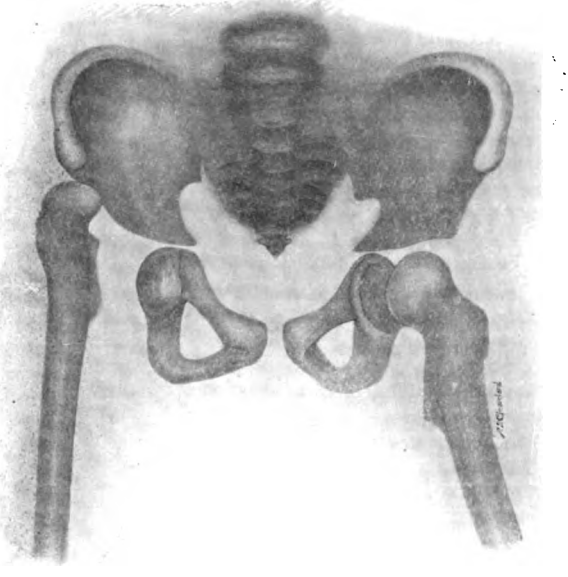
either congenital hip misplacement nor acute epiphysitis. There was now no evidence of hip disease. The limb was freely movable in all directions save abduction, which was somewhat restricted.

As before stated, the deformity was typical of congenital hip misplacement. A radiograph did not give information which would enable the inexperienced observer to make a differential diagnosis, but the writer ventures this observation, based on comparisons with a number



of radiographs of congenitally misplaced hips, all of which show a lesser space between the upper extremity of the femur and the pelvis. In fact, it may be said that the head of the bone invariably lies in contact with the ilium. The radiograph of the pathologic dislocation shows unusual distance between the pelvis and the thigh bone. This condition indicates not only absence of the head and neck of the bone, but an amount of soft tissue between the bones, which may explain why our best efforts at reduction are thwarted, except in rare cases.

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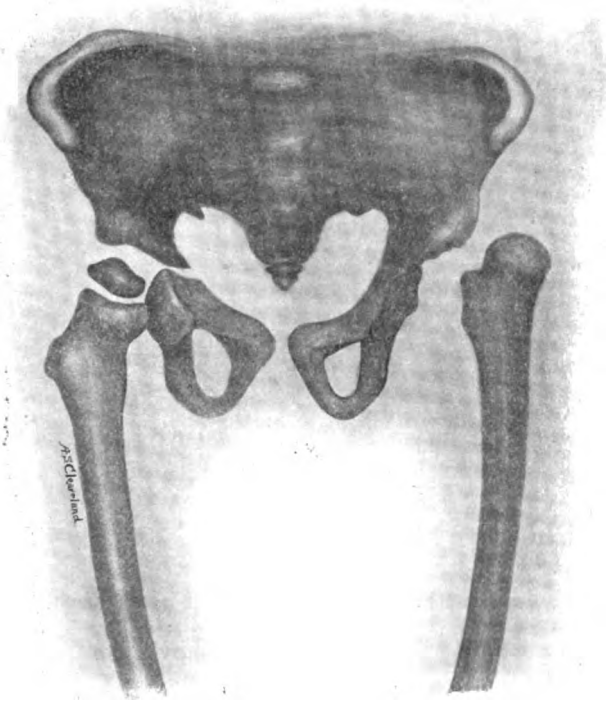
In an attempt at reduction in this case by the Lorenz bloodless method, nothing could be accomplished. The absence of the head seemed to be strikingly apparent. The bone could not be impigned against the pelvis, as it can in cases for which reduction is ordinarily attempted. I was not satisfied with this attempt, however, neither were the parents, who were solicitous that every-



thing be done to remedy the deformity and the disability. Therefore, the Lorenz-Hoffa cutting operation was done. The incision passed directly through the scar of the old incision, which enabled us to demonstrate the true character of the original trouble, i. e., a healed funnel-shaped depression over the capsular ligament indicated the site of the former sinus through which the destroyed

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epiphysis had been discharged in the form of pus and débris. A dissection into the former capsule showed this to be a closed cavity, practically a dense ligamentous structure, which precluded an approximation of the trochanters and acetabulum. I use the word trochanters advisedly, because none of the head, and practically none of the neck of the femur was demonstrable. The operation, therefore, was a failure. Literature furnishes abundant information on the occurrence of this condition, but little or nothing on the treatment of the deformity and disability. With the evident advancement in the treatment of hip misplacement, the writer has sought information from some of those who would be likely to avail themselves of anything offering encouragement in the handling of these perplexing cases. Wisner R. Townsend writes:

I have seen a great many cases and believe they should be treated as excised hips. Where there is no adduction and the upper end of the femur does not slip too much, a high shoe will suffice. If adduction exists I overcome it under ether, and put the limb up in marked abduction.

I have not treated any by the so-called Lorenz method, but could only believe it might be of use providing the upper end of the femur could be kept in the acetabular cavity, or in front and below the anterior superior spine, and a new socket thus formed with upper end of femur taking the place of the head, which has disappeared.

That these cases, when seen long after recovery, are very rarely correctly diagnosed is a fact, and I have had a number sent to me on the supposition that they were congenital dislocations.

Royal Whitman says:

I have performed both the open and the Lorenz method in these cases. The aim is, of course, to fix the femur in, or about, the acetabulum, that is, anterior to it, and to hold the limb finally for a long time in abduction and extension. One hopes thus to attain security.

One can hardly report on final results until many years have elapsed. My cases are still under treatment. Perfect cures are, of course, out of the question.

A letter from Professor Lorenz (whose work I had witnessed two years previously) replying to my letter

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requesting information along these lines, is of especial interest in this connection, and is as follows:

The diagnosis can always be made; the treatment can be the same as in cases of congenital hip dislocation, but never a perfect cure can be obtained. An improvement, however, is nearly always possible. Generally the head of the femur is more or less destroyed, sometimes nearly wanting, so that the upper extremity of the femur ends like a broomstick.

The first who called attention to these cases was my late master, Professor Albert. Reduction, as a rule, is scarcely possible; only one time I succeeded. In the other cases (they are rather frequent, these cases of pathological luxation after osteomyelitis or other infectious diseases), I change only the position of the leg, the flexion and adduction of the thigh being changed in an habitual abduction (lyorrhesis abductionem) and hyperextension of the thigh. I call this treatment, which is available also in other cases *die Functions verbesserung defecter Huftgelenke*. The condition for weight bearing is improved, the endurance in walking is augmented, but the limping will never disappear, although it can be lessened, too.

With this additional testimony, the writer would now be disposed to undertake this treatment, indorsed by practically all three of the distinguished authorities quoted, yet he would have reasons to doubt its usefulness in a case such as the one herewith reported. The treatment would seem rather severe to inflict, where so small a prospect of benefit is promised. The limp and disability, always unilateral in the cases, are really not so great as to be a serious handicap. Some years of experience will probably be necessary before the profession can decide fully the merits of intervention.

While the writer, with his limited experience, which was characterized by failure, would not desire to pose as a pessimist, yet it appears to him that the very nature of the anatomico-pathologic conditions present would seem to effectually preclude the possibility of successful treatment in many of these cases. That cases without too much destruction of the femoral head and neck will be improved by the approximation of the bone to the acetabulum, or placing it anterior and maintaining the parts in this position for a long time, as in congenital

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misplacement, seems not unreasonable, and, in view of the fact that nothing better is offered, should be tried.

That cases of epiphysitis occurring in young infants where the head and neck of the bone are largely cartilaginous and in a condition favorable to be destroyed completely, will leave a condition unfavorable to successful treatment, except as recommended by Townsend, i. e., as excised hips, by an extension sole to lessen the limp, and the inevitable scoliosis resulting from a tilted pelvis, would appear to be about all that can be done in some of these unfortunate cases.

Discussion such as is hoped to be elicited will favor a better understanding, perhaps, and tend to crystallize ideas relating to what now seems to be little understood generally and rarely practiced, save in the practice of a very few orthopedists.

DISCUSSION.

Dr. John Ridlon, Chicago—Some weeks ago Dr. Lord asked me for facts concerning this condition, and I told him that I had no recollection of any case, and, so far as I could ascertain, I had no record of any case that appeared to resemble congenital dislocation of the hip. By one of those curious circumstances two such cases have since come to me; one of them I have operated on and the other is waiting to see the results of the first operation. Both of the cases were in children and were of sudden onset, accompanied with great pain. Neither had had any abscess that was ever recognized or opened, and there were no scars. I was inclined to believe that it was a pneumococcus infection, and I was somewhat surprised at Dr. Lord's statement that his case was one of pneumococcus infection, and that there was an abscess, because I was under the impression that one did not get abscess in the pneumococcus infection. Now in these two cases the edge of the acetabulum was ragged and the greater trochanter was one-half inch or more above the upper border of the acetabulum, and the line of junction to the shaft where the neck had been was ragged. In the first case, a colored child, I found what I thought possibly was the shell of the former head of the bone, it being somewhat of that size and shape. Under an anesthetic I ventured to pull the leg down, so that the greater trochanter would be in the neighborhood of the acetabulum, and force it into the acetabulum, thinking that I might renew the inflammatory condition, and more likely cause the formation of adhesions which might result in permanent fixation. As I did

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the operation I could hear a crash, as though some partly diseased portion of the bone was being crushed. I could not make out whether it was the acetabulum or the greater trochanter. The patient has not recovered fully from the operation, but there is no pain, sensitiveness or temperature, and the patient appears to be perfectly comfortable.

The other case resembled the first exactly, excepting that the shell of the head was wanting, and there was a transparent area below the greater trochanter, as if the bone had been partly destroyed. I suggested in the second case the same operation as in the first. It seems to me that the only chance of securing satisfactory results is in pulling the greater trochanter down and placing it in contact with the acetabulum, holding it in place by mechanical appliances for many months and then, if necessary, putting on a leather support to hold it in place for many years. I do not think one should fear the inciting of undue inflammation, as it would seem by this inflammation we would get a greater degree of fixation and better results.

Dr. Wisner R. Townsend, New York—This paper, it seems to me, is particularly opportune, for the reason that the country is being scoured for patients with supposed dislocation that some surgeon may reduce a la Lorenz. The first question to be considered is that of diagnosis. If the diagnosis is correctly made the subsequent treatment may be correct. If it is incorrect it is very uncertain what the treatment may do. One point that seems to me of especial importance after the diagnosis, is the future of the child. I have had the misfortune to be able to follow some of these cases for ten or fifteen years, and those which were neglected were far worse off than those which were cared for. To my mind the points of most importance are to keep the thigh abducted and prevent irritation. The cases should be kept under observation for many years. The thigh can be placed in a plaster-of-paris bandage or a leather support or splints, if desired, and much good result. As far as reducing the supposed dislocation by the Lorenz method is concerned, I do not believe that we can accomplish much except by putting the bone in an anterior position. I have never seen a case of congenital dislocation in which you could not feel the head of the bone; sometimes it is very distinct, although deformed. In acute epiphysitis the head is almost entirely absent, and if the history of the previous abscess is secured it is a rather easy diagnosis to make. Without the head of the bone, of course, we can never have as perfect motion as in the normal child, and no method of treatment can restore the head.

Dr. John P. Lord, Omaha—Just a word in regard to the pneumococcus. As I have said, this condition was only suspected because the child had pneumonia. It occurred after the

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child was convalescing and, of course, a mixed infection might have caused the suppuration and the discharge. The remark made by Dr. Ridlon that pneumococcus infections of the joints do not terminate in abscess would tend to confuse us, if we continued to depend on the presence of the scar for diagnosis. The writer felt somewhat backward about bringing before the Section a subject which was so rare and of so comparatively little general interest, because I find that very few are informed outside of those working in special lines, and even these are undetermined. It is, therefore, very important, as Dr. Townsend suggests, that this matter be discussed at this time, in order that we may get our minds clear on this subject.

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NECESSITY FOR MORE CARE IN THE TREATMENT OF SKULL FRACTURES.

W. H. EARLES, M.D.
MILWAUKEE, WIS.

The substance of this paper is based on the following propositions:

1. Fractures of the skull are not always recognized as such until too late to receive proper treatment.

2. Fractures of the skull when not properly treated at or about the time of fracture, occasionally result in death, and if not in death in serious remote consequences.

3. Fractures of the skull, when properly treated, usually terminate satisfactorily.

Every practitioner is aware that a large number of skull depressions, with their usual concomitants, are constantly forcing themselves on our attention. It is, we believe, right to assume that surgeons are familiar with the mischief that such depressions create, and would not knowingly allow them to remain were they recognized at the time of injury. As no special reasons exist for these omissions, we are forced to the conclusion that carelessness at the time of the first examination is responsible for the errors in diagnosis and their consequent evil effects.

The conclusions of Hippocrates—sometimes credited to Sir Astley Cooper—that "No injury to the head is too slight to be despised, nor too severe to be despaired of"—were never clearer than to-day, and still many of us fail in appreciating their significance, or if appreciating, fail to profit by them.

An apparently insignificant scalp wound may be asso-

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ciated with a serious fracture beneath, and even a contusion of the scalp may cover a fracture, with depression and accompanying laceration of brain tissue and coverings. The scalp wounds may be ever so carefully dressed and the subsequent healing be ever so perfect, but unless our range of inquiry is sufficiently comprehensive to take in all possibilities, deeper injuries may remain, to be followed by headache, epilepsy, or even insanity. Usually these cases do not present themselves for examination until the evil effects of injury are fully established and little can be done for their relief.

Roberts tells us in his "Fractures of the Cranium" that their importance and interest center not in the damage done to the bone, but in the associated injuries sustained by the brain and its membranes. He also tells us that the inner table is nearly always more extensively broken than the outer. Keen says that "fractures of the inner table alone can only be suspected." Starr (Brain Surgery, p. 27) reports two cases operated on by McBurney, of which he says: "The pressure of splinters of bone cracked off from the inner table of the skull and imbedded in the brain in the motor area, for the arm with cysts at the same place was demonstrated." Da Costa warns us by writing: "The prognosis of fractures of the vault depends on the extent of brain injury, rather than on the extent of bone injury."

In this connection we must not forget that any injury sufficiently violent to produce a fracture of the skull, is also sufficiently violent to produce injuries to the soft parts beneath. In support of this statement we may be pardoned for submitting the following, taken from the clinical records of the writer: From an analysis of 86 cases where injury to the skull wall existed, 68 were accompanied with probable, and 57 with positive, evidence of cerebral disturbances. These conclusions were verified in 52 cases through operation. Clinical reports of competent observers, coupled with everyday experiences, have clearly demonstrated that blows or

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falls on the head may cause serious trouble, both present and prospective, without producing fracture to the skull wall. If this be true, how much more likelihood is there of such conditions being present when fracture exists, especially if that fracture be depressed. It is on the effects of these injuries, rather than on the injuries themselves, that we would lay emphasis, and to invite attention to the necessity of a full and correct diagnosis at or about the time of injury, in order that either condition may be properly treated. Every case of recent head injury, however trivial it may appear, should, we believe, be treated with the greatest consideration, lest damage to hidden and important structures escape our attention, thus leaving a foundation for future trouble which too often is irreparable.

What shall we do to improve existing conditions? Make a thorough examination at or about the time of injury if possible, and then rationally treat the conditions found. Open wide the scalp wound, carefully examine the bone beneath, and if this be found injured, then examine the brain. An examination of the tissues suspected of injury when cleanly and carefully made, does not expose the patient to any special dangers, while it may be of the most significant value, by determining conditions and leading to treatment that will result in the prevention of very undesirable consequences. This is a rational surgical procedure based on science and common sense. On this point Otto Schar, in the *Archives of Clinical History,* says: "Epilepsy following injury to the skull can, in the majority of cases, be avoided with almost absolute certainty if only active and proper treatment be instituted at the time of injury." Again we quote from Da Costa when he says: "Trephining cases where no symptoms exist, although there is marked depression, often prevents disastrous consequences arising in the future."

We believe that all fractures of the skull with de-

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pression should be trephined, the depressed bones elevated, and underlying soft parts carefully examined, and if found injured, repair attempted.

We believe that all fractures of the skull with or without depression when symptoms of cerebral disturbance exist, should be trephined. We believe that all skull fractures, regardless of the presence or absence of cerebral symptoms, should be carefully examined before the soft parts are closed over them.

In operation in no other part of the body does the surgeon close the wound until he has satisfied himself as well as may be, as to the conditions beneath.

Under ordinary conditions the necessary and proper treatment may be carried out. Thorough cleansing of the parts to be operated on may be secured in almost any room; the operator and assistants must be clean, as must the instruments, sponges and dressings. The scalp is raised, the underlying bone examined, and if fragments are found, they must be removed. A button of bone is then removed with the trephine and the parts beneath examined. If found necessary, the opening is to be enlarged with the chisel. If only the dura be torn, it may be united with catgut; if the brain tissue be injured, any ragged edges must be removed—the freshened edges approximated and so retained with fine sutures—all depressed bone must be elevated, when the scalp may be closed in the usual way with or without gauze drainage as circumstances may seem to warrant.

Every patient to-day, of whatever condition, is entitled to intelligent treatment when injured; every surgeon should be prepared to give this treatment when called on to do so. These statements are especially true when associated with injuries to the head. We should, therefore, aim to be thorough in our work, guided by the clinical experience of the past, to the end that full justice may be done both patient and doctor.

Carelessness in the treatment of the class of cases

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referred to, appears to be responsible for at least much subsequent suffering, and ought to be discouraged.

Drawing on the clinical experience of the able observers quoted in this paper, as well as from the daily experiences of practitioners generally, we are forced to the conviction that not all that is possible is being accomplished in head surgery. Even were the remote consequences less deplorable than we find them, there would still be sufficient reason for reformation along these lines.

We labor night and day with commendable energy, and write volumes on conditions of the appendix; the midnight lamp finds us devising contrivances for the repair of the intestines; the gall bladder and its ducts command our closest attention—then why make the skull, the storehouse of the most important organ in the body, a matter of secondary consideration?

We all know that any impairment of the brain seriously affects the entire economy. We should also know how when possible to prevent this impairment, for here, as nowhere else, do we recognize the force of the adage, "Prevention is better than cure."

There are a greater number of heads than appendices. By virtue of their exposed anatomic positions they are more frequently in need of repair than are the intestines. When seriously injured, they expose the patient to greater dangers than do gallstones.

Why not give them that consideration their importance entitles them to?

DISCUSSION.

DR. J. GARLAND SHERRILL, Louisville—This subject is one of great importance to all men who are doing surgery, especially cranial surgery, and I believe that many cases of this class are not treated properly as mentioned by the speaker. This occurs for many reasons, and a very important one is, that the diagnosis is not made, and we can only say that diagnosis of fracture with trouble within the cranium is not always easily made. I believe that the old classification of symptoms is largely responsible for this condition. It is possible to have grave lesions of the brain with but slight symptoms,

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and sometimes with extensive damage to the brain the patient will be able to be up and about, the symptoms coming later. If we have the symptoms of compression of the brain, then we have a demand for an operation, but there is no less a demand for operative procedure where the symptoms indicate what has been formally known as concussion of the brain. I believe when you make a diagnosis of concussion of the brain you should always make a thorough examination of the shaven scalp. Localized pain on pressure is of the greatest importance in making your diagnosis. In connection with this symptom the use of the percussion hammer or your finger will often elicit a crack in the skull, which you would not otherwise be able to discover. In connection with these symptoms you should watch the pulse, respiration and pupillary reaction; these are quite important. In these cases the temperature rises as the blood flows at the base of the brain and the pupil becomes dilated and fixed.

In concussion of the brain you often meet another symptom, a rapid irritable pulse, while the pupil is not fixed and dilated as in compression of the brain. Taking these things into consideration a diagnosis of trouble within the skull can be made, and when this fact has been established I believe that most of the fractures of the skull should be investigated, except those very serious fractures of the base of the skull where there is very little hope for relief, but I believe that the field for operative procedure will be widened, even in these cases. All depressed fractures of the skull and all compound fractures should be trephined, and even linear fractures, especially when brain symptoms are present.

DR. CARL WAGNER, Chicago—In connection with Dr. Earles' very suggestive paper I would like to report two cases which tend to illustrate the imperative necessity of operating on all cases of depressed fracture of the skull. Of these two, the first one represents the one extreme, where the injury appears to be so slight that it hardly seems worthy of attention, or even escapes notice, while the second typifies the other extreme in which the case is seemingly utterly hopeless and beyond human aid.

In the first case the mother called me on account of an eruption of the skin, which she took for scarlet fever. The skin eruption did not resemble that of scarlet fever or measles, neither were any throat symptoms present. Temperature 102. The child had had several attacks of convulsions, and on being put on the floor described semi-circles to the right and then fell, insteading of walking in a straight line. This attracted my attention to the brain, and examination of the head I found a sensitive little spot and a small crust covering a slight abrasion of the scalp.

The mother then seemed to remember that the child had

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fallen against the sharp edge of the leg of the bed about two weeks previously. The child had not complained at all at that time. On operating, a stellate fracture with depression of the bone and pus between bone and scalp, as well as oozing through between the bone splinters from underneath, was disclosed. Another abscess was found directly under the dura mater, containing about a half-teaspoonful of pus. Immediately after the operation the temperature became normal and the child recovered quickly. This case was presented to the North Chicago Medical Society three years after the operation, where I could show that the whole defect of the bone had been closed up by new osseus tissue.

The second case, a boy of 7, fell from the third story on a stone pavement, head first. Dr. Williams and Dr. H. Wagner, who had been attending the boy during the two hours since the accident, informed me that the child had been lying absolutely motionless, with knees and arms flexed, with stertorous Cheyne-Stokes respiration, during the entire time, almost pulseless, the pupils dilated and fixed and did not respond to the effect of light. There was a profuse hemorrhage from the right ear, both nostrils and mouth. On top of the right side of the head near the frontal region of the skull a deep depression large enough to admit three fingers could be seen.

I made an extensive Lannelongue incision, without anesthetic. The injured field was exposed. The anterior and posterior branches of middle meningeal arteries were tied, the ruptured longitudinal sinus tamponed, the lateral sinus on the right side blocked with gauze. The bony defect was very nearly as large as the palm of the hand. A bi-parietal fracture, which had torn the longitudinal sinus, extended through the temporal bone, which was afterwards verified by the examination of the ear, where Dr. Gradle found a scar in the drum and bone. The boy left the hospital fourteen days after in good health and has been for the last seven years a good, bright scholar in school.

Dr. T. J. Sullivan, Chicago—Cases of fracture of the skull may be divided into two classes: simple and compound. The simple cases are cases to be placed under observation, and when the conditions warrant interference by surgical intervention. The compound fractures, of course, should always receive all the relief that is afforded by modern surgery, and the wound should be dressed with a primary antiseptic dressing at the time of the traumatism, so that when the patient is received by the surgeon the case from the time of the injury to the time of the operation is controlled by primary antiseptic dressing. The best antiseptic is bichlorid of mercury, in a strength of 1 to 1000. All the compound fractures certainly require surgical intervention. In these cases the operation should be proceeded with with all surgical precaution in the way of elevating the fracture and restoring the condition of the patient.

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In cases where the meningeal vessels are torn, and where it is very difficult to do the operation without hemorrhages, we can safely place a quantity of the normal salt solution within the dura. In some of those cases we have very severe hemorrhage from the meningeal arteries, and good may be derived from the little device referred to. The Mosaic may be secured to the dura by careful adjustment with a very fine through-and-through catgut suture. In this way we can control the hemorrhage, and after about forty-eight hours we can reduce the Mosaic and insert packing, which may be done at once in those cases, where hemorrhage is not an important factor. In that way we provide against the danger of adhesions of the dura and the scalp. Later in those cases in which that procedure has not been carried out and we have adhesions between the dura and the scalp, we have a very beautiful little procedure that we can resort to. By making a large flap and dissecting it off carefully and then by running the chisel in between the parts, we can keep the dura separated from the scalp and provide against adhesions. Of course, five minutes is too short a time to systematically dissect these parts. It seems to me that all classes of injury to the skull can be divided into two classes, simple and compound, and all cases of simple fracture should be kept under observation and surgical interference undertaken as soon as the motor symptoms are noticed. The compound fractures demand immediate operation under the most thorough aseptic methods. When sepsis does occur, a median incision should be made in the skull and drainage provided. At least in one instance of compound fracture of the skull, which had gone over for eighteen months after the time of the injury, it was possible to save the patient by those great multiple incisions. In this case the temperature had run up very high, the patient had had convulsions, but was relieved by this operation.

DR. B. B. DAVIS, Omaha, Neb.—When I see a case of head injury I always try to keep this point in mind. It does not matter how much the fracture or how small the fracture is, or how much injury there is to the membrane or to the bone, the point that we are concerned with more than anything else is the extent of the injury to the brain. I have been very much surprised in some instances to see quite an extensive fracture of the bone, with practically no injury to the dura or to the brain, and, on the other hand, I have seen cases where the fracture was insignificant, and have found a great deal of injury to the dura and perhaps to the gray matter of the brain. To decide when to do an operation immediately and when not to do an operation is not always so easy, and I think we should always consider, first, is there any danger if we do not do the operation, and second, are we going to leave this pa-

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tient in a bad condition if we do not do it? I think we have trephined in two or three instances unnecessarily. In some cases I have not found enough pathology to warrant the operation. The question is whether there is not enough cicatricial tissue to form dural adhesions, so that in the future that patient may have paralysis due, not to the original injury, but to the trephining. I think we should not do this operation unless it is absolutely necessary.

DR. G. S. BROWN, Birmingham, Ala.—I merely wish to report a case of injury to the middle meningeal artery with resulting paralysis. I merely report it because it is a case of very unusual occurrence, and I never heard of one being reported before. It occurred in my practice about three weeks ago. I operated on it and found a very small clot about the size of a white bean. The convulsions and paralysis and all the other symptoms disappeared two hours after the operation, and in ten days the child was up and well.

DR. CHARLES H. LEMON, Milwaukee, Wis.—In injuries to the skull, especially those caused by a fall from a height, we sometimes find serious intracranial disturbance without demonstrable hemorrhage within the cranial cavity, and I think it is the experience of those who have seen many of these cases that some cases are allowed to die under a diagnosis of concussion of the brain, which might possibly have been saved if subjected to operative procedure. There is a pathologic condition of the brain following trauma that is oftentimes overlooked. We may have, and we frequently do have, contusion of the brain itself and its membranes, and as the result of that contusion we have edema of the brain causing intracranial pressure of a fatal character which might be avoided by trephining and drainage. We are expecting in the brain a power of resorption that we do not expect in other tissues of the body. We seem to have lost sight of the fact that in the arrest of the fall, when the delicate structure of the brain is contused by its sudden sharp contact with its bony envelope, it must undergo the same pathologic process, with all its attendant inflammatory changes, that other soft tissues similarly injured undergo more favorably situated for the purpose of expansion.

There recently came under my observation the case of a man who fell forty feet, receiving a compound fracture of the right wrist with numerous contusions of the body without apparent injury to the head. Ten days after the injury he developed a partial paralysis of the right arm and right leg and became markedly comatose, the hemiplegia becoming complete on the eleventh day. On the eleventh day his temperature was 102, pulse 145 and respirations 10 per minute. Coma complete. I trephined the skull low down on the left side, opening the middle fossa. There was no extradural hemorrhage and no

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pulsation of the brain could be seen. The dura was incised. A contused area of the brain bulged into the wound. The center of this area was markedly ecchymotic and the surrounding cortex of the brain appeared infiltrated. A grooved director was inserted which permitted the escape of a large amount of cerebrospinal fluid, relieving the intracranial pressure, and at the end of ten minutes the brain began to pulsate vigorously. The wound was drained by strands of catgut and heavy moist dressings used to favor the relief of tension by drainage. In three days all paralysis had disappeared, the man was able to talk and the temperature dropped to 100 degrees.

I cite this case because it illustrates that in all cases of severe injury to the skull there is likely to be contusion of the brain without hemorrhage followed by inflammatory reaction which may produce fatal intracranial pressure. This may occur without demonstrable signs of injury to the head, so that in order to give these patients every possible chance for recovery the skull should be opened for the purpose of relieving tension and by providing free drainage afford the brain the greatest possible room for expansion.

Dr. T. C. Witherspoon, St. Louis—I take it for granted that the subject under discussion is injury to the brain following fracture of the skull. There are four sources of danger: First, hemorrhage; second, laceration or more extensive pulpification; third, presence of bone or foreign body in the brain or making pressure on it; fourth, sepsis. The most dangerous form of fracture as far as infection is concerned is of the base of the skull. It is certainly bad practice to irrigate the nasal cavity, as some recommend, to aid in disinfection. The water is too often the conveyor of infection. Above all things, the air of the room should be kept moist to prevent crust formation as far as possible.

As to exploration in case of hemorrhage or laceration, I feel the dura is too often opened. Adhesions are necessarily formed at the cut in the dura, and epilepsy is a possible sequence. These cases suffer from sudden movements or jars. Two cases have come under my observation in which I was sorely tempted to open the dura initially, and time has demonstrated the wisdom of not doing so. About 14 years ago a gentleman was thrown from his horse and suffered a fracture at the base of the skull. A profound coma lasted for a while, which left, on clearing, a distinct hemianopsia. At this time I favored exploration, but he fell to the care of another surgeon and I lost sight of him. Six months ago he returned to me, asking that I explore his brain to find out why he still had the hemianopsia. I advised against this, stating it was too late to accomplish anything regardless of the primary cause. In a short time he

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returned with a statement made out by his attorney to the effect that I would be in no way responsible for the outcome in case I operated. With him he brought some friends to urge this on me. On opening the skull we found absolutely nothing in the area of the cuneus. Evidently the original injury was a laceration deep in the basilar area.

The second case was that of a man with fractured skull due to a rock falling on his head from a height. The cutaneous wound was small, but the fracture involved the major portion of the left side of the skull. There was no paralysis, but complete aphasia; neither could he write. His understanding of written language was questionable, likewise that which he heard. The bone just above the commencement of the Sylvian fissure was most depressed. This was removed. The remaining area on the side of the head was left intact after adjusting the fragments of attached bone as best I could. A primary healing followed, and at present he can speak well enough to get about and ask for necessities. The distinct localization made it tempting to explore further in each case, but I am sure it would have been more harmful than beneficial.

DR. W. H. EARLES, Milwaukee, Wis., closing—This paper has been read in the hope that it may stimulate a more thorough application of the knowledge we have on this subject. The point that I especially wish to emphasize is that we do not exercise that amount of care and judgment that we should in these cases. Nowhere else in our operative work are we so tempted to hurry up the operation without satisfying ourselves as to the exact conditions present.

A few years ago I was called to treat a man who was suffering from epilepsy. He gave a history of good health until one year prior to the time that I saw him, when he fractured his skull in jumping from a fourth-story window. He told me that he had a silver plate in his skull. I did not credit the silver plate part of the history, and did an operation on the injured side of the head, when I found this plate (showing plate). His epilepsy, however, continued. I was satisfied that there was some condition present closely associated with his fits, and, after waiting two weeks, I had his head again shaved. On making the second examination I found on the opposite side of the head from that operated on, a very small scar and beneath it a depressed fracture. The scar was so small as to have escaped my attention at the time of the first operation, and the original wound had apparently been so insignificant as to have escaped the notice of the operator at the time of the primary operation. He had seen the injury on one side and performed an operation for its repair, but the injury on the other side being insignificant in appearance, did not receive apparently the attention it deserved. After the second opera-

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tion the epileptic seizures discontinued, and did not reappear as long as the man was under my observation—about six months. I do not know what the final results were.

I cite this case to show the necessity of great care in examining the class of injuries referred to. I think if we will exercise what knowledge we have, and be more careful in our primary examination of the patients, we will have fewer cases of traumatic epilepsy.

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EPISPADIAS.

REPORT OF A CASE OPERATED ON BY A MODIFICATION OF CANTWELL'S METHOD.

JAMES B. BULLITT, M.D.
LOUISVILLE, KY.

The purpose of this paper is to again call attention very briefly to an almost ideal operation for the relatively rare but distressing deformity, epispadias; and, further, to describe a modification of the original operation which the writer found it necessary to make in the single case on which he had the opportunity of operating.

This operation, described by Cantwell[1] in 1895, performed by Herbert Page,[2] in 1898, and again by Parham and Martin[2] in 1900, seems not to have gained the recognition it deserves, and not to have found its way into the recent text-books of surgery.

Bryant voices the sentiment of practically all the text-book writers when he says: "The ability to secure as satisfactory results in this deformity as have been secured in hypospadias has not yet been attained."

The procedures usually recommended are similar to the plastic operations applicable to the condition of hypospadias, and of these the methods of Thiersch and Duplay are the best and most useful examples. But these operations leave much to be desired, both from the standpoint of functional result, in overcoming the incontinence, and the length of time required for the progressive steps.

Cantwell's operation, having for its object the transplantation of the newly formed urethra to its normal

1. Annals of Surgery, December, 1895.
2. Ibid., January, 1901.

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situation beneath the body of the penis, permits a quick result to be obtained, and relieves entirely, or in a marked degree, the distressing incontinence.

TECHNIC BY CANTWELL.

Briefly described, the operation of Cantwell is made as follows: A curved pair of forceps is first introduced into the bladder and its point made to bulge the peri-

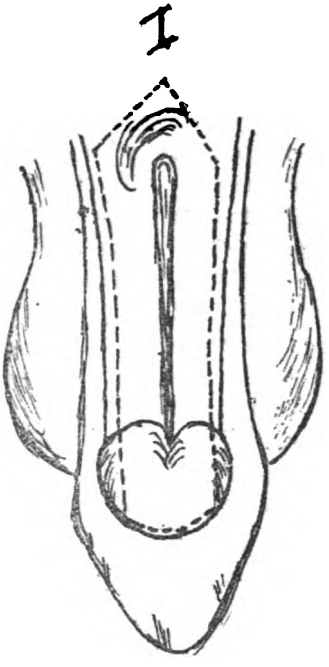

Fig. 1.—After Cantwell.

neum. This is cut down on and drainage of the bladder provided by means of a rubber tube which is left in place until the process of healing is complete. Next an incision is made on both sides of the penis at the junction of the mucous membrane and the skin beginning proximally at the opening of the bladder, and extending distally to the end of the glans penis. The meatus is usually just under the pubic arch. The mucous

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membrane lining the groove on the dorsum of the penis, and marked out by these incisions, is now dissected up, care being taken to carry the dissection well back to the infundibulum, almost to the bladder wall.

When this is thoroughly done the urethra can be drawn out surprisingly. This mucous membrane flap is now converted into a urethral tube by suturing its free

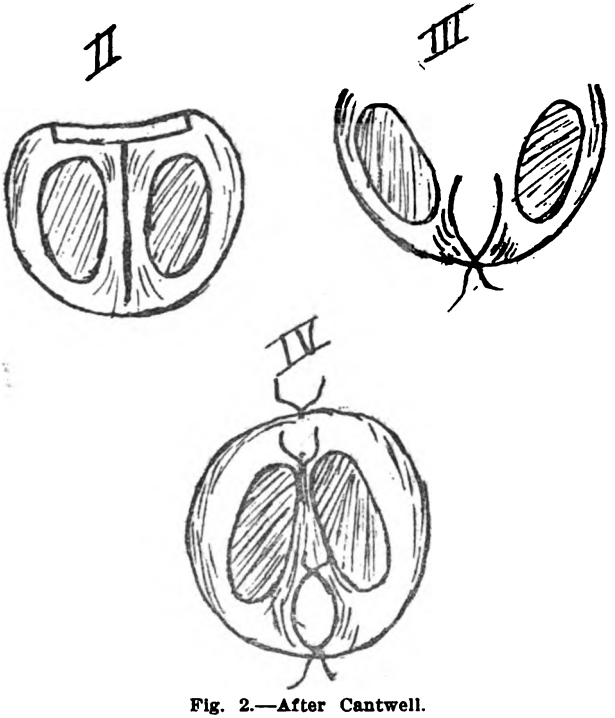

Fig. 2.—After Cantwell.

edges together, and should be long enough to reach quite to the end of the glans penis.

Next a new bed for the urethra is made by dissecting apart the two cavernous bodies, leaving them attached only by the skin at the under surface of the penis. In the normal penis this separation would be most difficult, but in epispadias is extremely easy. This separation

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should be carried well back behind the pubic arch, so as to transplant deeply the urethra for its whole length; a slight incision is necessary in the glans. The urethra is now transplanted into this groove between the corpora cavernosa, a few sutures serving to anchor it to the underlying skin of the penis. Above the urethra the corpora cavernosa are brought together and united by continuous suture; and finally the overlying skin, which is usually abundant for the purpose, is sutured over all. This produces a penis which presents a surprisingly normal aspect, except for the apron of foreskin.

If healing occurs by first intention, the whole procedure is through with in two weeks' time. The patient is able to retain his urine almost perfectly in some cases, and can void a full stream through a meatus at the normal situation in the glans penis.

MODIFIED METHODS.

Cantwell recommended that the operation be not undertaken under 10 years of age, because of the small size of the parts and the presumption that the younger the patient the more dangerous any operation. The case reported by Parham and Martin, however, was only 5 years of age, and my own was 7 years of age. There are certainly reasons why it is advantageous to perform the operation at an earlier age than originally recommended by Cantwell. My own patient, operated on in 1901, was a boy of 7 years, otherwise healthy and well developed. The meatus was beneath the pubic arch, and the foreskin hung down in a well-marked apron. On dissecting up the mucous membrane over the sulcus and the glans penis, it was found impossible to avoid injuring this portion of the mucous membrane to such an extent that it had to be discarded and cut away entirely. As a consequence, the new made urethra was too short; even after thoroughly mobilizing it and drawing it well forward it could only be made to reach a point well behind the glans penis. It was therefore found necessary to adopt the suggestion made by Par-

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ham to combine Van Hook's method[3] of tubular canalization with Cantwell's urethral transplantation. Van Hook, in a case of hypospadias, made a canal by tunneling through the glans penis, and then lined this canal with a pedunculated flap, converted by suture into a tube, taken from the preputial hood. The distal end of this flap, now become proximal, was finally sutured to the distal end of the urethra, so completing the canal.

In my case a sufficient flap was cut from the underlying preputial apron, was then converted into a tube by suture, and finally was drawn through a tunnel made through the glans penis. It was then united over a soft catheter to the already formed proximal portion of the

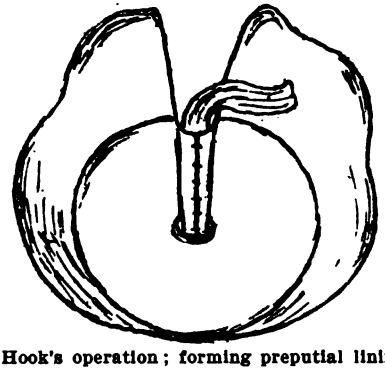

Fig. 3.—Van Hook's operation; forming preputial lining for tunnel through glans penis.

urethra. The remaining steps of the operation were carried out in accordance with Cantwell's recommendations. The success of the operation was surprising. With the exception of a pin-hole opening situated a little in front of the pubic arch, there was healing throughout by first intention. At the end of ten days the perineal drainage was withdrawn, and three weeks after operation the boy was exhibited to the Falls City Medical Society. He had been instructed to retain his urine for several hours before exhibition, a thing utterly impossible before operation. Just as he was placed on the

3. Annals of Surgery, vol. xxiii.

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table he found it impossible to longer retain his urine, and discharged several ounces over the table and carpet in a stream from a meatus situated at the end of the glans penis.

Singularly enough, I found the closure of the pin-hole fistula more difficult than the original operation. Having failed in one effort to close it, opportunity has not yet presented to successfully deal with it.

This boy's continence has markedly improved. A recent report informs me that there is occasional dribbling by day and sometimes wetting of the bed at night; but this latter is not by dribbling, but by voiding at one time a bladder full of urine.

In conclusion, I desire to say that I feel satisfied that no other operation, in my hands, could have produced anything like so good a result in anything like the short space of time.

DISCUSSION.

DR. F. W. PARHAM, New Orleans—I think the condition of epispadias, although an extremely rare condition, merits our serious consideration, because when present it is so very distressing. I find myself in the singular position of making suggestions in the treatment of a condition wherein I have not had a single case to operate on. However, I have had the good fortune to assist my friend, Dr. Martin, in such a case, and I have seen another case in which Dr. Fenner has obtained a very satisfactory result by the method commended in the paper of Dr. Bullitt. The old operations of Nélaton, Rosenberger and others did not fulfill the conditions because, although they effected the re-establishment of the canal, this was too pouch-like, and the incontinence was not relieved. Beside, the time required was too long. None of the later operations have proved satisfactory, except that of Cantwell of Trenton, endorsed by Dr. Bullitt in his paper. I have looked up the subject thoroughly, and I find no procedure that can compare with it in simplicity and results. Cantwell's operation at once places the canal below the organ, where it belongs, and the whole operation can be finished at one sitting. In the normal penis the union of the corpora is very intimate, indeed, so intimate that the fibers of one side seem actually to decussate, but the connection is very frail in the epispadiac condition. English, in fact, reported one case where the corpora were completely separated. In some cases the separation may be made without cutting. In the

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technic of the operation I have learned in the case in which I assisted Dr. Martin that it is well to carry the dissection well up under the pubes so as to mobilize the trough freely, and then to make the canal carefully before separating the corpora and carrying it to its place under the organ. One difficulty in the operation is to get the canal placed far enough forward in order to allow for retraction. In some cases a second operation will be required to locate the meatus properly. I believe the addition of the Van Hook plan, as carried out by Dr. Bullitt, will prove of decided benefit, because it assures the meatus at the proper point, and I feel personally indebted to Dr. Bullitt for showing by his case that it has distinct advantages.

Dr. E. D. Martin, New Orleans—My case amounted almost to exstrophy of the bladder. It was necessary to dissect an anterior flap from the pubis in order to complete the upper border of the urethra. This was sutured on either side and the tube, being completed, was buried between the corpora. The case has been greatly improved, though the incontinence has not been entirely overcome. This I hope to correct with the use of paraffin injections.

In regard to hypospadias, I would like to make a suggestion which I think is of some value. I had very recently a case in which I tried the suggestions of both Rochet and Nove-Josserand. The method of the former of making a tube of scrotal tissue and passing it under the skin was only partially successful. The latter, of wrapping a Thiersch graft around a catheter and pulling it through the slit, failed also, and I then divided the corpora the full length of the deformity, laid them wide open and covered the entire raw surface with a Thiersch graft. This succeeded beautifully. I then brought the corpora together, forming a deep groove all the way. I pared the edges freely, held the corpora in position with mattress sutures and sutured the margin of the skin with catgut. All united with the exception of a small fistula on the junction of the newly-formed canals, and I agree with Dr. Bullitt that these are always difficult to close, and that perineal drainage is always necessary to insure success.

Dr. Erasmus D. Fenner, New Orleans—I had a case in which I had an opportunity to treat acute epispadias, and my case was very considerably below what I believe to be the proper age limit in these cases. The patient was not quite five years of age. Fortunately for me, however, the little boy was remarkably intelligent for his age, and assisted me in every possible way by his great patience, thus overcoming the objection that has been made to doing the operation at this age. In connection with this operation I wish to say that my knowledge of the procedure is due entirely to the excellent recollection of my friend, Dr. Parham. Shortly afterward I had an

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opportunity of seeing Dr. Martin's case, and the steps of the operation were simply the mere separation of the parts by Cantwell's procedure. I was impressed, first, by the expansibility of the tube, and second, I was impressed by the fact that it was free, so that it could easily be drawn up above the urethra after it had been placed in its position. I was further impressed by the absolute necessity of using a silk suture. Up to that time I had used chromicized catgut. I decided to use internal silk suture. The approximation was satisfactory, and for a few days the case did well, but shortly afterwards the parts began to swell, and there developed between the skin and the urethra a large abscess which subsequently required opening up of the skin, and breaking the abscess and allowing it to escape. Fortunately, however, the operation was not associated with any serious fistula in the new canal, and after a rather tedious convalescence, my little patient recovered, having a perfectly normal restoration of the anatomy, although I found that the meatus was placed a little too far back for the normal condition. I have not yet made up my mind how to unite that. I am convinced, however, if we could let the patients wait until they are 10 or 11 years of age, so that they can have control of the bladder, we could get much better results.

I have suggested this same procedure for hypospadias. Not long ago I had an opportunity of operating on a patient suffering from hypospadias. In this case, we concluded that we would leave out the buttonhole in the peritoneum. The patient left after the operation in a very much worse condition than before. Taking this case into consideration, as well as my case of epispadias, it would seem that the buttonhole in the peritoneum should not be omitted.

Dr. James B. Bullitt, Louisville—The speakers have testified that this operation gives fairly good results, and in some cases surprisingly good results. I would have liked to have heard from some of the other gentlemen who have employed other methods in regard to what they have been able to accomplish. I have only had two cases of this condition, and the first case was operated on by the method usually applicable to hypospadias, and the patient was not improved, and I have no doubt that there are others who have had the same experience. So it is especially gratifying to me to have accomplished the result I did in the second case. Outside of this small fistulous opening the patient was cured, and he got up inside of three weeks' time. I agree with Dr. Fenner that the drainage of the bladder through the perineum is always necessary. I believe also when you have a fistula it would be better to drain the bladder through the perineum.

What part of the operation is the most difficult? In the first place getting the mucous membrane clear to the end of the

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glans penis. It is nearly always impossible to find sufficient mucous membrane to reach to the end of the glans penis. While the urethra can be drawn out surprisingly, it also retracts afterward somewhat surprisingly. I am sure that Dr. Parham is entitled to great credit for the suggestions he has made. I believe in the case I operated on, if I had separated the corpora cavernosa further back, I would have had a better result, and this fistula would probably not have occurred. The third point is that the formation of the canal from the point where the abnormal meatus is situated is somewhat difficult. However, I believe from the success of this operation in my own particular case, and from these other operations that have been reported, that it is very much superior to any of the other operations that have been proposed.

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TUBERCULOSIS OF THE MAMMARY GLAND

A. H. LEVINGS, M.D.
MILWAUKEE, WIS.

Dr. Scudder,[1] in an exhaustive article on "Tuberculosis of the Mammary Gland," states that an examination of the literature showed only eighty cases reported up to that time, twenty-three of which were rejected on account of imperfect data. This list, however, does not include twelve cases reported by Albert in his work on surgery.

Tubercular infection is so frequently met in the various tissues and glands of the body that it seems unusual that only fifty-seven well authenticated cases of tuberculosis in the mammary gland should have been reported up to 1898. It is, of course, to be expected that not all cases diagnosed as tuberculosis of this gland were reported, but had they been, the number would still be small, and the cases reported since 1892 are so few that we are forced to believe that the disease often goes unrecognized.

It is conceded that tuberculosis of the mammary gland is most frequently found in young women between the ages of 20 and 35, or during the period when the gland is functionally most active. A few cases have been reported as occurring before and after menstrual life. Roswell Park reported a case in a girl 12 years of age, and Mr. Payne saw an infant with a tubercular abscess of the breast, following which there was general tuberculosis and death. Several other cases have been

1. Amer. Jour. Med. Sci., July, 1898.

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reported at ages under 20. Cases have also occurred in women after 50 years, and even after 60 years of age. The condition is occasionally observed in men. In Dr. Scudder's eighty cases six were males, and in forty cases reported by Mandry one was a male. It is said that more than one-half of the women affected have borne children, and that in a considerable number of these the process has originated during pregnancy.

It is held by the great majority of writers, and this I believe to be true, that the process is to be observed most frequently in spare, weakly, anemic individuals, in those who have inherited the so-called scrofulous diathesis or tubercular predisposition, and especially in such as have a parent or near relatives who have or are suffering from tuberculosis. Tubercular infection of the mammary gland may be primary or secondary. When primary it may occur through the milk ducts or through abrasions of the nipple or of the skin covering the breast. It is thought that the great majority of cases are secondary to a tubercular process in the lymphatic glands of the axilla or neck, or to one in an adjacent rib, pleura or lung. The focus, however, may be situated in distant bones, in the genito-urinary or intestinal tract, in the peritoneum or skin. When secondary and the foci are situated more or less remotely, infection may occur, and frequently does, through the arterial circulation. Infection undoubtedly takes place, however, in many of these cases through the lymphatic circulation by a retrograde process. Retrograde infection or infection carried against the lymph current is seen every day in cases of carcinoma. A case of epithelioma of the nipple came under my observation in which there were metastatic growths in the membranes of the brain, these having taken place through the lymphatic circulation. It is also of frequent occurrence in carcinoma of the mammary gland to observe enlargement of the lymphatic glands of the neck. Although it is held that the bacillus of tubercu-

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losis is non-motile, it is probably true that these bacilli are often carried against the normal lymph current by cellular action or by reverse currents. Infection may also occur by contiguity of structure in cases where the submammary tissues, the adjacent ribs, or parietal pleura are implicated. If infection occurs through the milk ducts, the process must be situated primarily within the ducts or the acini. If the bacilli reach the breast through the circulation, lymphatic or arterial, they would naturally be arrested in the tissues directly surrounding the alveoli, as here the arteries which supply the gland break up into a network of capillaries, while the lymphatic radicles take origin within and about the lobules of the gland. When infection occurs through contiguity of structure the connective tissue of the gland will be primarily implicated.

THE ANATOMY.

It might be well in this connection to review briefly the anatomy of the lymphatics of the chest for the purpose of determining the possible channels of infection to the mammary gland through these vessels. It is generally held that the lymphatics in the mammary gland of the female are more highly developed than they are in any other gland in the body. They are generally divided into two groups, the superficial, which passes to the axilla, and the deep, which follows largely the branches of the internal mammary artery and goes to the anterior mediastinum. The axillary glands may be divided into three chains. The first, or superior, lies along the lower border of the pectoralis minor muscle, and is in relation with the long thoracic vessels.

It receives most of the lymphatics from the upper and outer portion of the mammary gland, the front of the chest and from the abdominal wall above the umbilicus. The second or middle chain is situated in the adipose tissue of the axilla and on the inside of the axillary vein. It receives the lymphatics largely from the upper extremity, and the efferent vessels from both

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the superior and posterior chains. The posterior group lies along the posterior border of the axilla in relation with the subscapular vessel. It receives the lymphatics from the scapular region of the back and from the inner and lower quadrant of the breast. The deep lymphatics of the gland anastomose freely with the superficial and with those from the pectoral fascia. Some of these vessels from the outer side go to the axilla, while others accompany the intercostal vessels and enter the right lymphatic or left thoracic duct. The deep lymphatics, which originate in the inner hemisphere of the breast and in the inner portion of the pectoral muscles, penetrate the second, third and fourth intercostal spaces and communicate with the glands, six or eight in number, which are situated along the internal mammary artery.

LYMPHATICS OF THE LUNGS.

There are two sets, the superficial and deep. The superficial is placed beneath the pleura as a minute plexus covering the outer surface of the lung, communicating freely with the pleural cavity, and invading the interlobular tissue. It terminates at the root of the lung in the bronchial glands. The deep set commences in the mucous lining of the bronchial tubes and accompanying the vessels terminates in the pulmonary lymphatic glands situated along the walls of the small bronchi and in the angles of their subdivisions. There are about forty glands in the right lung and thirty in the left. Efferent vessels from these pulmonary glands join with the superficial lymphatic vessels and end in the bronchial glands. The efferent vessels from the bronchial glands communicate with the mediastinal glands and traverse the tracheal and esophageal glands, terminating on the right side in the right lymphatic, and on the left in the thoracic duct. There may be, then, a direct circuit of lymph by retrograde action from the neck and axilla to the breast, and from the lungs, pleura and pulmonary and bronchial glands through the

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mediastinal glands and their lymphatics along the branches of the internal mammary artery to the breast. The arteries which supply the breast are from the thoracico-acromialis to the upper lobes, from the long thoracic and external mammary to the outer lobes, and from the anterior intercostal and perforating branches of the internal mammary to the inner lobes. Each gland consists of from fifteen to twenty tubo-racemose glands bound together by connective tissue and united into a hemispherical mass by adipose tissue. Each lobe has its own excretory duct. The acini, either sacular or in the form of tubules, are grouped together to constitute lobules. They are limited by a distinct membrane and lined by either columnar or polyhedral epithelial cells. The blood vessels run mostly in the superficial tissues radiating toward the areola, and from these vessels branches penetrate into the glandular mass and pass between the lobules, giving off twigs which break up into capillaries enclosing the alveoli. Naturally, then, if the bacilli are brought by the blood vessels to the gland they would become implanted on the alveoli or they might pass through their walls into the interior. The latter unquestionably may occur, and does during lactation. If the bacilli are arrested in the capillaries the tubercular process set up would be an interacinous one. If they pass into an acinus or duct and become arrested the infectious process would be within the acinus or duct. The lymphatics also run in the connective tissue stroma of the gland and commence as a network of capillaries within and around the lobules. Their radicles have practically the same distribution as have the capillary blood vessels. In consequence of a retrograde action in the lymph current the bacilli would also become implanted about the acinous wall, or possibly carried into its interior.

PATHOLOGY.

The bacilli being implanted within the tissues of the gland set up an irritation which is followed by the usual

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pathologic change. Round cell infiltration occurs with the formation of epithelioid and giant cells. The bacilli are often to be found in the exudate, while tubercles or tubercular masses with caseation or pus formation often occur. It is characteristic of those cases which remain for a long time as hard nodes for the microscope to show the formation of a large quantity of interacinous connective tissue. In a considerable number of my cases some of the hard nodes were made up largely of dense fibrous tissue situated between sparsely distributed acini. In these cases there will be areas of distinct caseation or those in which giant cells are to be found or the bacilli of tuberculosis and even in some in which these conditions are not demonstrated the axillary glands will show caseation and the bacilli of tuberculosis. In cases in which the infection is directly through the milk ducts or glandular structure, the process, aside from its situation, will be much the same as before with the exception that in a considerable number of these pus may be forced from the abscess cavity by pressure along the ducts and from the nipple.

SYMPTOMS AND COURSE.

The clinical picture presented by a tubercular process within the breast is a variable one. It will depend largely on the stage of the disease during which the examination is made, on the number of foci primarily infected, and also on the fact as to whether the process is primary or secondary. In many of these cases, as can be readily appreciated, the primary disease will be of such importance or severity that the condition of the breast, even if severe, will be of little or no moment. The patient's attention may first be called to the process by pain which is usually early experienced, pretty continuous and has a dull, heavy, aching or burning character. Not unfrequently, however, the pain is scarcely noticeable, and the patient's attention is first attracted to the breast in consequence of finding therein a node or nodes. These nodes, and there are usually

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more than one, are reasonably hard, not very sensitive and quite irregular. They can not be distinctly separated from the glandular structure, and ordinarily vary in size from that of a hazel nut to half an inch or an inch and a half in diameter. They are very seldom round, but are flat or have a very irregular contour. These nodes are often distinctly separated, but still lie in the same quadrant of the breast. The fact of their being multiple nodes is a characteristic of the disease. The gland as a rule is not enlarged, and on simple inspection nothing may be seen. The axillary glands during this early stage are enlarged and may be palpated. As the condition progresses the nodes increase in size, though very slowly, possibly coalesce, become more elastic, and finally impart a sense of fluctuation. They may become adherent to the skin and the contents of the abscess be discharged through a fistulous tract. Occasionally several fistulæ are formed in consequence of the breaking down of many nodes. While ordinarily the gland is not enlarged during the first stage of the disease, later, if pus in any considerable amount is formed, the breast becomes noticeably enlarged. If the process is situated near the posterior surface this may become attached to and quite immovable from the pectoral fascia. The nipple, in a goodly number of cases, is retracted.

DIAGNOSIS.

The diagnosis will depend on the antecedents and appearance of the patient, the history of the case and the physical examination. The antecedents will often show scrofula or tuberculosis. The appearance is often that of a thin, anemic, weakly woman of lessened resistance, while the history may establish the probability of tubercular processes in other parts of the body. The examination will usually disclose, if made before the formation of an abscess, one, more frequently two or three, quite hard, very irregular, well defined, not specially sensitive nodes which are inseparable from the

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glandular structure. The axillary glands are enlarged—it is stated in two-thirds of the cases—and the nipple often retracted. When pus has formed the use of the hypodermic needle and the microscope will materially aid in establishing the diagnosis. When fistulæ have formed, the process being chronic, the diagnosis is easy. The process must be differentiated from scirrhus, actinomycosis, benign growths and from cysts due to chronic inflammatory processes. In scirrhus the patient is usually more than fifty years of age. The node is single and harder than in tuberculosis. The history of the cases and the cachexia are different. In actinomycosis the thickened, indurated, leathery skin, the yellow granules and the use of the microscope will establish the diagnosis. In benign growths, such as fibroids, the fact that they are usually single and distinctly encapsulated without enlargement of the axillary glands, will be sufficient to distinguish them. Multiple cysts, especially when of small size and due to a chronic inflammatory process, present the greatest difficulties perhaps in the way of diagnosis. Many of these small cysts are not to be differentiated by touch from solid nodes. In these cysts, however, the axillary glands are not usually enlarged, the history of the case is often different, and the use of the hypodermic needle will afford valuable assistance.

I have been able to find scarcely more than a dozen cases reported up to date in the United States, and believing that very many of the cases of chronic mastitis and most of those of chronic abscess of the breast are really tubercular, to say nothing of those cases in which there are distinct nodes running a chronic course, I am forced to the conclusion that in the past there has been in the great majority of cases of tuberculosis of the mammary gland a failure to make a diagnosis.

REPORT OF CASES.

Seven cases of tuberculosis of the mammary gland, all in females, have come under my observation during the

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past two years. Five of these patients were single. Of the two who were married but one had borne children. In three cases both breasts were affected.

CASE 1.—The first patient was 35 years of age and single. She had noticed for a year and a half an enlargement first in the right and then in the left breast. In placing the palm of the hand flat against the gland many small indurations could be felt. These seemed of considerable size when the breast was pinched up between the thumb and fingers. The nodes were hard, irregular and reasonably well defined, but seemed to be a part of the glandular structure. The axillary glands on both sides were implicated. The nipples were not retracted. The patient's condition, aside from this, was reasonably good.

Both breasts and axillary glands were removed. The breasts were found dotted with small circumscribed abscesses, which in some cases were directly connected with the ducts and in which the bacilli of tuberculosis were demonstrated to exist. Patient made a good recovery. In this case there was nothing in the patient's history or antecedents indicative of tuberculosis and there were no other foci anywhere in the body which could be detected.

CASE 2.—An unmarried woman, 30 years of age, with a predisposition to tuberculosis, noticed seven months previous to examination, a gradually increasing, hard swelling in the right axilla. Latterly the swelling had occasioned such extreme pain in the right arm that it was scarcely endurable. During the past two months several small, hard, well circumscribed indurations could be felt within the breast structure.

The breast was excised, and with it the major portion of the pectoral muscles. An abscess of considerable size situated in the axilla and adherent to the pectoral muscle was unavoidably broken into. A large number of axillary glands were so intimately adherent to the axillary vein that excision of a portion of the vein was necessary. This was done after double ligation with catgut. The glands and abscess were causing severe pressure on the brachial plexus, some of the smaller branches of which were excised with the abscess. The breast was found on multiple incision to contain a large number of small collections of pus, many of which were not larger than a pea. Some of these were in direct connection with the ducts. The patient had never complained of anything more than an occasional burning pain within the breast.

Patient's family history was as follows: Her father was drowned, mother died of pneumonia at an advanced age, an uncle and a cousin died of consumption. There were three children, all of whom are living. The glands of the axilla showed numerous tubercular bacilli as well as many points of

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caseation. The process in the breast in this case was evidently secondary to the infection of the axilla.

CASE 3.—Mrs. R., aged 40, mother of three children. Very spare in figure, anemic, presents the appearance of one having but slight physical resistance. In her family history a relative of her father was supposed to have died of tubercular peritonitis, while a brother had his leg amputated for tuberculosis of the bone. After the birth of her third child eight years previously she suffered from a mammary abscess, and has been since in poor physical condition. For the past few months the patient had noticed a small, hard lump in the left breast. At the time of the examination there were two very noticeable, quite hard, reasonably well-defined nodes which evidently were inseparable from the glandular structure. One was in the upper and the other in the lower quadrant of the left breast. In the right breast there were also two or three indurations. From one of these, when pressure was made, there was a discharge from the nipple. The nipples were not retracted. The glands in both axilla were enlarged.

The breasts and axillary glands were removed. The pathologic findings showed that the glands were tubercular. The patient, one year after the operation, shows indications of pulmonary disease.

CASE 4.—An unmarried woman, aged 31, had been for several years in delicate health in consequence of a chronic uterine and ovarian inflammation. She had worked hard as a nurse and was thin in flesh, debilitated and anemic. Her family history shows the father and mother to be living and well. There is no tuberculosis in the immediate family. A brother of the father and a sister of the mother, however, died of consumption. For four years patient has noticed a gradually-increasing enlargement in the right axilla. For a few months there has been some soreness and hardness in the right breast with slight fever. The axillary glands have caused the patient a good deal of pain. In the breast there is an illy-defined, not well circumscribed induration situated in the upper quadrant. If the breast is picked up between the thumb and fingers there is a marked induration.

The breast and axillary glands were removed. The breast, on incision, showed that the hardened area had undergone caseous degeneration. The axillary glands were found to extend along the vessels filling more or less the axillary space as far as the clavicle, making a section of the pectoral muscles necessary in order to remove them. Many of the axillary glands were in a state of caseous degeneration, and contained bacilli in large numbers. The patient, since the operation, has shown decided improvement, and although at times annoyed by a cough she has gained in flesh and strength.

CASE 5.—A single woman, aged 44. Father and mother lived

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to be old. No tuberculosis in family. Patient had a severe pulmonary hemorrhage twenty years ago and a second one year ago. Both from the right lung. In the right apex there is prolonged expiration with much rattling and a decided dullness. There is considerable cough and some expectoration. The latter contains tubercle bacilli. During the last eight months there has appeared in the left breast, just above the nipple, a mass two inches long by half an inch in thickness. This area is quite hard, and from it several strands pass out to the border of the breast, while two or three run in toward the nipple. The axillary glands are enlarged. Patient, although having some continued fever, looks comparatively well.

Operation was not advised on account of the condition of the lung.

CASE 6.—Female, aged 30, of spare figure, is anemic and not strong. Never, however, has suffered any serious illness. Family history good. For several months she has noticed hardened areas in both breasts. The condition has caused a good deal of anxiety and the patient has apparently lost flesh and strength. Has no cough. On examination there are several indistinct and separate hardened areas in each breast. Nipples not retracted. Glands in both axillæ enlarged.

Axillary glands and breasts removed. Sections show hardened areas in the breast and the axillary glands to contain caseous material in which the bacilli of tuberculosis are found.

CASE 7.—Female, aged 36. Married nine years; never pregnant. Spare in figure, weak and anemic. Never has been ill. Family history good. She has noticed in the right breast more or less of pain for the past three months, also a swelling, which has gradually increased in size. At the time of examination there was a reasonably soft, fluctuating growth the size of a hen's egg situated in the upper and outer quadrant of the gland.

The mass was only mildly sensitive on examination. There were also several small indurations in the breast. The axillary glands were distinctly enlarged. Patient's temperature was not above 99. In the outer quadrant of the left breast there was also a soft, not well-defined and fluctuating mass as large as a small orange, while directly above the nipple were two hard and not well-defined indurations. Glands in both axillæ were enlarged.

The patient refused to have the breast entirely removed, consequently free excisions were made of the fluctuating masses, these excisions being made to include the indurated areas. In cutting across the ducts many of these were seen to be in intimate relation with the abscess cavities and to contain pus. The pus in both cavities was found on microscopic examination to contain the bacilli of tuberculosis.

Of these seven cases two were secondary to tubercu-

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losis of the axillary glands, while one was secondary to tuberculosis of the lung. Of the six cases operated on five seem to have completely recovered.

TREATMENT.

This will depend largely on the general condition of the patient and the extent of the disease in the breast. If the process in the gland is secondary to a severe and non-curable condition situated elsewhere in the body nothing more than palliation should be practiced. If the infection in the gland is secondary and the primary focus not severe or amenable to treatment, then there should be an effort made to eradicate the infection in the gland. If there be but a single collection of pus without adjacent nodes, indicating but a single focus of infection, the abscess may be incised, washed out thoroughly, curetted and drained. This course has been successfully practiced, and is recommended by Warren. If multiple foci of infection exist, and they are confined to a single quadrant of the breast, this portion may be excised. It is, however, the better practice where dissemination has occurred to excise the entire breast. If the axillary glands are implicated, as they usually are, they should be removed.

CONCLUSIONS.

Tuberculosis of the mammary gland is not an unfrequent condition, but one which goes unrecognized. The process may remain for months, and even years, in the form of hard, irregular, reasonably well circumscribed nodes. Liquefaction and pus formation are secondary and later processes. Tuberculosis of the breast occurs with especial frequency during menstrual life. It occurs with greatest frequency in single women. The condition is more often primary than has been generally supposed. The tubercular infection often implicates both glands nearly simultaneously. Palliative treatment may be practiced when the process is circumscribed. When the processes are diffuse radical measures should be recommended.

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DISCUSSION.

DR. B. B. DAVIS, Omaha—A case under my observation had a very large tumor and the axillary glands were considerably involved. At one point in the breast there had been a perforation and fistula with a history of considerable material being discharged, which under microscopic examination was demonstrated to contain tubercle bacilli. In the other case, I think I should have erred had I not recently read a very able article by a German operator, in which he discussed in detail the operation. This was in a comparatively young woman, about 30 years of age, if I remember rightly. Although there seemed to be one nodule, it was separate and I found on examination that it consisted of three different nodules, agglutinated and in a state of degeneration. All I did was to excise that portion of the process containing the nodules. There was no enlargement of the axillary glands and the patient recovered. In the other case I did the same kind of an operation that I should have done if the case had been carcinoma of the breast.

Another point is in regard to the temperature. In these tubercular cases which have existed for any considerable length of time we nearly always have some rise of temperature in the evening, and frequently subnormal in the morning, and this was particularly characteristic in the first case I mentioned. I have been under the impression that a good many of these cases in which there is a hard nodule of the breast and the breast is removed, supposedly as a carcinomatous case, are in reality tubercular, and I believe tuberculosis of the mammary glands is a much more common condition than is generally supposed.

DR. T. J. SULLIVAN, Chicago—There is no reason why tuberculosis should not be found in the mammary gland, just as it is found in every other portion of the body, and I believe that there is no tissue of the human body that is not liable to be infected. I think we can even go further and recall the statement of some of the authors that the tubercular germs in a greater or lesser number exist in all our bodies and that sooner or later we may, any of us, have it. That being true, we may find the tubercular germs in any portion of the body.

I had a case of this condition occurring in a woman, of average health, mother of ten children, who had always enjoyed good health, and had been compelled to work hard to maintain the family. She had had swelling in the breast, appearing about six months previously, after working hard. Previous to presenting herself to me for examination she had been examined by a physician, who informed her that she had carcinoma. The appearance would indicate that she was suffering from carcinoma. I placed my hand on the breast im-

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mediately over the tumor and detected a small, hard nodule. In presenting her to a class of medical men the following diagnosis was made: Retraction of the nipple; hard nodule; no axillary enlargement; healthy and well; no pain.

She was kept under observation for a couple of weeks, at the end of which time the nodule had enlarged slightly. I then was in considerable doubt as to the nature of the tumor and removed a small wedge under local anesthesia. Pathologic examination of this wedge revealed the fact that it was due to an inflammatory process. I then decided to remove the whole breast in a radical operation, including the axillary glands. I did so, and the appearance of the nodule presented to my mind the appearance of scirrhus of the breast. and a good pathologist who was present at the observation said that undoubtedly it presented all the appearances of scirrhus. The operation was complete, however, without further attack on the axillary glands, and subsequent pathologic examination revealed marked tuberculosis, which healed rapidly.

It is time to call attention to this subject and give these patients the advantage of early operation.

Dr. William Knight, Hartford, Conn.—Just a little criticism of one point in regard to abscess. Dr. Levings said you could open the tumor and drain thoroughly. The tendency in treatment of those cases is to prevent absorption. It seems to me that it is folly to interfere with it. It also seems to me much better to open it and drain thoroughly with plenty of absorbent cotton. I think we will get much better results by the treatment of abscess in this manner.

Dr. Andrew W. Morton, San Francisco—I have had experience with only one case which puzzled us considerably. We used the tubercular serum to make the diagnosis, and got the characteristic reaction which we usually get in using this serum where there are tubercles. After the removal of the gland the microscopic examination showed the diagnosis to be correct.

Dr. A. H. Levings, Milwaukee—I may add that one additional case has come under my observation since this article was written. Of my cases of tuberculosis of the mammary gland one was secondary to a tubercular process of the lungs, while two were secondary to tubercular processes in the axilla. The others, so far as I was able to determine, were primary within the breast itself. In some of these I think the infection was through the milk ducts. In others the infection was through the circulation, arterial or lymphatic. I am very confident that we have been mistaking these cases for carcinoma because the two conditions may present practically the same symptoms, in that there is a hard nodule, retraction of the nipple and enlargement of the axillary glands.

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In regard to the treatment of opening and curetting an abscess, I am of the opinion that in a case in which there is but a single abscess with no out-lying nodes, this treatment may be recommended, and probably will, if properly carried out, result in a large number of cures. This, in fact, is the treatment generally which we are accustomed to follow in cases of tubercular abscess.

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FRACTURE OF THE UPPER THIRD OF THE FEMUR SUCCESSFULLY TREATED WITH PLASTER OF PARIS WITHOUT EXTENSION.

L. SEXTON, M.D.
NEW ORLEANS.

Fractures of the shaft of the femur are very common accidents, despite the strength of the bone. The lower end of the bone is more frequently broken than the upper. Fractures of the upper third are usually due to indirect violence, and of the lower third to direct injury. The course of the fracture is usually oblique. Marked angular, rotary and longitudinal displacements usually attend these fractures. The lower fragment is usually drawn to the inner side and behind the upper; this tendency to deformity is greatest when the fracture occurs in the upper third.

Every kind and variety of fracture is liable to occur to the femur. On account of the large muscular attachments to the bone, displacements are nearly always present in fractures of the femur, and this is especially true in relation to fractures of the upper third, when the bone is tilted forward by the action of the psoas, and abducted and turned out by the gluteus maximus and external rotators of the thigh, at the same time the lower end is drawn upward and to the inner side by the hamstring and adductor muscles. The weight of the foot assists these adductors in the eversion of the foot, which is a symptom of this fracture. The proper appliances for treatment of fracture of the femur has caused wide and varied discussions with many diversified views; there

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are perhaps more special apparatus invented and discarded for the treatment of these fractures of the femur than for any other bone of the body, but the one point of extension is agreed on by all.

Recumbent position, a suitable bed with foot elevated, a hair mattress, not too soft, and immobilized retention of the fragments are indispensable to success.

The nates are prevented from sinking into the mattress by placing boards between the mattress and springs of the bed. Extension is usually obtained by cord and weight applied to the leg over a pulley attached to the foot of the bed. The foot of the bed is often raised six inches and the extension weight increased up to ten pounds in order to overcome the muscular contraction so that the fragments can be brought down together.

Many surgeons have called attention to the difficulty in approximating the fractured ends, especially when they occur in the upper third of the femur, and in maintaining them in apposition after they have once been reduced. A casual glance through our different museums will prove that this is the seat of permanent deformities and usual shortening of the fractured limb, which has caused so many suits for damages and brought out so many cork-sole shoes and criticisms on surgeons.

Dr. Allis even considered this shortening and displacement so serious that he advised immediately cutting down on the fracture and wiring the bones together. In the case of a transverse fracture with lateral displacement and overlapping more than an ordinary extension apparatus to hold it in place is required. Direct lateral and anterior pressure is absolutely essential for the proper union and keeping in place of broken fragments. Under a general anesthetic, with the patient placed on a hard table and by making firm pressure on the upper fragment of the bone, while an assistant makes strong extension and counter-extension by pulling directly on the foot and body, the fragments can usually be approximated.

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Owing to the mass of fleshy muscles which encompass the bone it is rather hard to say exactly when these fragments are in apposition. Good, all-around anterior lateral support for these fractured ends is best obtained by a plaster-of-paris dressing, after the bones have once been properly adjusted and swelling has abated. Owing to the thick muscular attachments of the bone, too much padding is not indicated at this point, provided the fracture is of the simple variety. The adipose tissue and muscles soon yield to the plaster dressing, which if at first seems rather tight, is soon loosened by the atrophy of the muscles and adipose tissue under rest and continued pressure, hence moderate support as can best be had by a plaster-of-paris dressing applied all around the limb, as a rule, gives better results than the long side splint, extension and sand bag and various other appliances in use. In the treatment of these cases the double inclined plane has been practically abandoned. Buck's extension by weight and pulley is still used by many surgeons. Dr. Hamilton's preference is for a long-sided splint extending from the foot to the axilla, much after the pattern of Liston's long extension splint. Valkman's sliding foot-rest is of great assistance in treatment of this fracture in many cases.

In a recent case of fracture of the upper third in a little boy 8 years old, with marked elevation of the upper fragment accompanied by eversion of the foot and drawing up of the lower fragment, I had a most successful result by the following simple method of one plaster-of-paris dressing which was not disturbed from the time of its application a few hours after the fracture until its removal four weeks after the accident, in which we found perfect union without any shortening. The little patient in pushing a swing that in its rebound came within six inches of the ground was caught under the swing-box seat, in which five or six other children were seated, the fracture being produced by direct violence, with some, though not very great, contusion of the soft parts.

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The little patient was placed on a hard table with pelvic rest, the leg being held in extension; he was thoroughly relaxed with chloroform and the fracture reduced by extension, counter-extension and manipulation. While in this position a 2-inch Z. O. plaster was applied on both sides of the leg above the knee with a loop around the heel to provide for extension in the event of shortening; several roller bandages of padded cotton were applied around the limb thoroughly protecting the heels, condyles and trochanter and iliac spine; this batting was applied rather thin around the fleshy thigh proper, was extended around the pelvis, and up as high as the stomach, being thickly applied over the abdomen. With two assistants maintaining extension and counter-extension, plaster-of-paris bandages were applied from the ball of the great toe on around the fractured limb across the pelvis and up to the stomach. These bandages were interspersed with plaster-of-paris muck, not too wet, giving additional support between each layer.

With the pelvic rest it was not hard to apply the dressing, so that it came well up in the groin, which had been previously padded, sufficient space being left posterially for the use of the bed-pan. We were careful to sufficiently pad the abdomen to accommodate gaseous extensions likely to occur after dinner, and were particular to carry the bandage up around the body as high as the stomach, so that the point of fracture was in reality at the middle of the plaster cast. In applying the first plaster bandage the upper end of the fragment was depressed by firm pressure, and, as said before, the bandages were reinforced by the additional plaster at the point of the break. When the plaster had set, we found that the length of the two limbs were exactly the same; which relative position remained until a cure had been accomplished, so that at no time was it necessary to add any weights to our adhesive straps which had been applied for extension in the event of any shortening.

The patient while confined to the recumbent position

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could move around on his hard mattress with comparative ease, the dressings did not become soiled from any source during the month's treatment, there were no bed or pressure sores in the case; only two or three casual visits were made during the treatment, and the result, as seen by the patient before you, was all that could be expected.

This case has been reported to show the extended use of plaster of paris in treatment of fractures of the femur, especially in children; its advantages are: its cheapness, the ease with which it is applied, its perfect adaptability to the shape of the limb, combining the good effects of an all-around splint, its cleanliness; it is a one-dressing treatment with nothing to get out of place, and the splendid results which follow its perfect application should commend it to surgeons in suitable cases in preference to the numerous complicated appliances recommended for the treatment of fracture of the femur, especially in children.

The second case brought before you is an engineer with fracture of the lower third, but treated with the plaster dressing without any extension, and, as you see, with no shortening, and with complete recovery within seven weeks' time.

I will show you another patient treated without any extension method. He was an engineer on the Illinois Central Railroad, and in a collision jumped from his engine into a pile of cross-ties, the result being a backward dislocation of the knee-joint and fracture of the lower third of the femur.

I dressed the wound in plaster of paris, as in the first case. We did not have quite enough padding on the first dressing, and we had to remove the bandage and put on a second plaster-of-paris dressing on account of the swelling.

The ankylosis observed in the knee is not the result of the fracture, but is caused by the extreme backward dislocation of the joint. It has only been about seven

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weeks since the accident occurred, but there is not a particle of shortening, as you can observe by examination, and by the use of the tape measure. The halt in walking is a result of the dislocation, and not of the fracture. Considering the double damage of the fracture and the dislocation, the patient certainly was fortunate in the termination of this case, as he soon expects to be riding on his engine, doing his regular duties as engineer.

DISCUSSION.

DR. JOHN P. LORD, Omaha—I think the more expert we become in the use of plaster of paris the more constantly do we find an increasing field for it. While I am not prepared to say that all cases of fracture of the femur should be treated by plaster, yet I think you can perhaps treat the greater number of them in this way. Fractures just below the trochanters, for instance, I would not think of treating by the use of the plaster cast, because the extreme upward displacement of the proximal fragments would preclude the possibility of a good result in at least many of the cases. It has been my experience that the so-called intracapsular fractures are best treated by the plaster. Extension can also be used in addition to the plaster, if necessary, which I think is an excellent idea, and is too often neglected in the cases in which plaster is used. I think we can do with the plaster all that is required. I consider fracture of the femur in children comparatively easy to treat. I think this principle should govern our actions in the treatment of these cases. We should first reduce the fracture to as near a perfect position as possible, and then put on such a dressing as will maintain absolutely the proper position of the fragments, a dressing, indeed, that will continue to maintain this position of the fragments. The old-fashioned method of using sandbags and other splints relatively insecure, I think, at the best is poor practice. You can not depend on such things. We have all seen our preceptors adjust sandbags and rearrange the dressings every day. If there is anything that will encourage non-union it is that sort of thing. I think plaster does accomplish the result in a more definite and perfect manner than any other method.

DR. W. W. GRANT, Denver—The essayist referred to Dr. Allis' declaration as to the difficulty of maintaining the apposition of the fragments and the necessity of cutting down and wiring the ends. In an article which he published several years ago, Lane of London stated that it was not so much muscular action that caused the displacement as it was the inflammatory conditions and blood about the ends of the frag-

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ments. In consequence of this Dr. Lane advised the cutting down and wiring the fragments—of course, under the most perfect aseptic conditions. I believe this practice often desirable in fractures of the elbow joint. However much truth there may be in his declaration that it is due chiefly to blood clot and to inflammatory conditions, we do know that the best results so far obtained have been by some form of extension with fixed apparatus around the limb. The old Buck method is today not improved on in the ordinary treatment of fractures of the shaft of the femur, coupled with the application of such splints as we may see fit to use. I would hesitate to use plaster immediately in most fractures of the femur. I believe it to be a better surgical procedure to wait until the inflammation has subsided. We know that swelling results immediately after the accident and after four or five days it has usually subsided. There will be no union during this time, and it is best to wait until the swelling has subsided before applying the plaster. It is particularly important during this time that you should see the condition of the limb every day. Legs have had to be amputated because of the failure or inability to see the patient often after the application of the plaster. Therefore, one loses nothing by delaying the application of the plaster cast for this length of time. I believe in these cases there is a better dressing than plaster—silicate of potash. It can be applied just as easily, but it does not dry so quickly, and will require several hours to harden perfectly. When the silicate of potash is dry it is very light and is just as efficient, and if you prefer the ambulatory treatment there is no comparison. It is so much lighter, cleaner, much neater and more easily and quickly removed.

Dr. John W. Brandau, Clarksville, Tenn.—The method which I will describe I have found very efficient in three cases of fracture of the femur in children. I exhibited a model of this splint two years ago before the State Medical Association of Tennesseee. In the first place I make a board splint out of some light wood, about three-quarters of an inch thick, as wide as and a little longer than the patient's body, so as to give rest to the head and extend a little below the patient's foot with sound limb extended. The next thing is to make a thigh splint, which is firmly attached to the body splint at such an angle as will hold the fragments best in apposition, and on the side corresponding to injury. Then a leg splint running parallel to the body splint, with proximal end attached to thigh piece, with a support at the lower or distal end of the leg splint which rests on and is fastened to the body splint, thus forming an irregular arch. The splint should be made by measuring the sound leg and thigh and may be made longer or shorter, according to the amount of extension one wants to

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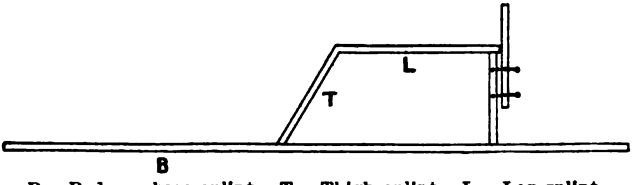
apply. The extension of thigh is also regulated by the padding one puts on the leg piece. If necessary, one can apply a foot splint adjusted so as to make extension on the leg, if that is also fractured, as per drawing below. The whole splint is then padded in order to make it as soft as possible for the patient's body and padding secured by roller bandages. The patient is then placed on the splint on his back, and the body firmly fastened to the base splint by a roller bandage in such a manner as to immobilize the trunk, which I think is important in the treatment of fractures of the femur in children. The entire limb is next secured to the splint by a roller bandage. In addition to this splint one should use short coaptation splints to the thigh anteriorly and laterally, so as to hold the fragments more securely in position. To secure these splints in position either a roller bandage, as above suggested, or adhesive strips may be used, and I find the latter convenient because they will not slip. The sound limb should be fixed to the body splint by strips which can be readily untied to allow the limb to be flexed in order to cleanse the child, etc. The splint can be easily made, nothing being



B.—Body or base splint. T.—Thigh splint. L.—Leg splint.

required but a hatchet, nails, some light boards, cotton and bandages. The little child with this splint can be applied to the breast, carried out in the open air, and can be placed on either side in order to prevent hypostatic congestion of the lungs. I have had no trouble with the circulation in using this apparatus. The part on which the patient's buttocks rest may be covered by ruber cloth, or a fenestrum may be made in the cases of older children. The end of the apparatus on which the head rests should be kept a little more elevated than the foot, in order to prevent the dejecta from running back under the patient's body. The apparatus is very light when made of white pine or poplar wood.

Dr. J. W. Andrews, Mankato, Minn.—I don't think that anything has come before this convention of greater importance than this subject of the treatment of fractures, and it just occurred to me, as Dr. Grant was speaking, that if every surgeon would follow his plan and have less to do with the side splint and complicated apparatus, the results would be far better. It is not an easy matter to get good results in fractures of the femur. It is probably not very difficult

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to give the patient a fairly useful limb, but to get results without shortening and without deformity is not so easy to do. And while a quarter of a century ago a physician could very well be content with some shortening, a surgeon who gets much shortening to-day is not inculpable. I well remember hearing the late Moses Gunn of Chicago, after some one had read a paper before a meeting of the American Medical Association, in which he reported having gotten a perfect result; Dr. Gunn rose from his seat and said he wished to place himself on record as saying that no man could get a perfect result in fracture of the femur. That day is past, and at the present time, where we have a fairly useful limb, but there is some deformity, we do not consider that we have gotten a perfect result. As Dr. Grant has said, it is most important to keep the limb so that it can be seen for the first few days until the inflammation, if any, has subsided, during which time the old methods of extension can be applied, after which time the extension should be continued and the limb placed in plaster of paris. I believe that if that method is carried out, the results produced by it will be as good as can be produced by any other method of treatment. In reference to the objections made by Dr. Grant as to the weight of the cast and the untidiness of the plaster-of-paris dressing, little need be said for it is a small objection, and so far as having an apparatus that our patients can walk around with, or the ambulatory treatment, I do not believe that many surgeons care to have their patients with a fracture of the femur walk around much during the first three or four weeks at least.

Dr. J. D. Maury, New York—I was very much interested in the description given by Dr. Brandau of the splint which he applies in these cases, because it suggests to my mind the straight angle chair used by Sayre to relieve adult patients who have been in bed and are suffering from hypostatic pneumonia. In the City Hospital, New York, we simply used an old rocking chair, with a hole cut in the seat for the movement of the patient's bowels. The patient is then placed in it, being sure that the seat of the chair is longer than from the legs to the region of the lower back, and the patient is then arranged in such position as will give him comfort. Gravity is sufficient in these cases to give all the extension necessary. In regard to the plaster of paris, we have been using a modification of this method in New York, which seems much superior to the "glass" bandages. About a year ago I learned from a wall decorator that they used dextrin in making the cornices of the modern buildings and it occurred to me to incorporate some of this in the plaster of paris. We have used it in 10 per cent. strength by volume, simply mixing it dry and making bandages of crinoline in the

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usual manner. It is a very useful addition and in a measure does away with the weight of the plaster of paris. I found that it was not an original idea and that it had been used a good many years ago by Velpeau, but I learned that Dr. Weir and others in New York were not familiar with its use, and I thought probably the members of this section might not be. In the treatment of those forms of injury to the lower extremity in which the patient may be allowed to walk without crutches it is invaluable. It is also applicable for the making of spondylitis jackets. Put on the ordinary plaster of paris and then dry it. We have been drying it by one of those torches used by painters to clean off paint, we then put on about one thickness 10 per cent. dextrin crinoline bandages. This gives the plaster a yellowish hue and makes it as hard as adamant. It is not quite so porous as the plaster alone. At the Columbia Laboratory there are some experiments being made to determine the relative porosity of the two substances. Clinically we find that it does not make the cast hot enough to interfere with the comfort of the patient, and if such should be the case, fenestræ may be placed at such frequent intervals as to more than compensate for any such limitation. The cast, although very hard and tough, cuts very readily with a sharp pruning knife if the line of section be thoroughly wet with water.

Dr. D. W. Crouse, Waterloo, Iowa—I had a new experience the last year in a case of ununited fracture of the femur that had non-union after a varied treatment of three months. The fracture was close to the condyles and was comminuted. The patient was 18 years of age at the time of the accident and in vigorous health. The attending surgeon placed the leg in plaster cast from the first, for six weeks. When the cast was removed it was found to be ununited; a new fixed dressing was applied and the patient put on crutches and treatment continued for six weeks, with the patient walking about, with the same unsuccessful result. He was again placed in bed with pulley extension for six weeks more when he was brought to the hospital for the purpose of cutting down and wiring the ends together. The ends were found separated by muscular tissue and fascia a full inch. The ends of the bones were uneven and some pieces of bone loose from the shaft entirely—the ends of the bones were sawed off and approximated and wired. He did well for 10 days when he suddenly developed a hemorrhage and lost a large amount of blood before the case was under control, and in great danger of his life. A forced amputation was made in the middle third of the femur and transfusion of saline solution made at the same time and although nearly pulseless in the beginning, he was put to bed in rather a better condition than when the operation was commenced. Examination

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of limb amputated disclosed what was already known that the popliteal artery had beaten against the irregular crest of the fractured bone and had worn the coat of the artery through and nothing but amputation was left to be done. The lesson taught is that the posterior fragments should present no projection, the bone is to be lined with the posterior aspect of limb in adjusting a fracture near the condyles of the femur.

DR. LUTHER SEXTON, New Orleans—A liquid glass dressing is out of the question in a hot climate like this where it would soon become moistened by perspiration. I do not know how it would do in a cold climate, or how it might be with the dextrin, but I have never seen a liquid glass dressing applied to the fracture of the femur as a permanent dressing. The doctor's conception in regard to the patients walking around with fracture of the femur, I think, is remarkable and must apply to the convalescing period. We usually confine our patients in bed for at least one month, during which time we expect absolute quiet. After this walking and the upright position is encouraged. In regard to plaster fixation I claim that the mistake made in applying the dressing in many of these cases is that they do not carry the support up high enough. In these cases the plaster of paris was carried as high up as the stomach, the stomach, of course being well padded. We put on about as much plaster above the fracture point as we did below. I am not claiming that this is the proper dressing in all cases. I applied the Z.O. plaster in order to produce extension, if I need it. The little boy is as nimble as ever, and though the fracture was in the upper third of the bone there is no deformity or shortening. In the application of this plaster dressing, I believe it is absolutely necessary to have an assistant hold the fractured bones in position until the plaster-of-paris dressing is firmly applied. One of the points that I would like tc emphasize is that you should have more of the plaster of paris above the fracture; do not have the dressing all below the fracture. In the case of the little boy, the point of fracture was actually in the middle of the plaster-of-paris cast. Now, in regard to the cast becoming soiled and not being hard enough, I have usually found it hard enough when it comes to take it off. If you wish to make it harder and render it so that it will not soil, you can paint it over with shellac. I have the cast preserved which was on the little boy, and the only soiling it got was from the money he put into it. He used it as a savings bank, for he got a dollar a day for keeping quiet, which was a great help in the treatment.

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CLOSURE OF WOUNDS.

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The methods of closing wounds now in vogue are not the best. This opinion is based on personal experience, observation of the work of others, inquiry and reading, and is the excuse I have for the presentation of this paper. I do not claim either priority or originality in the methods of wound closure advocated in this paper. My object in writing it is chiefly to urge a general adoption of the improved methods, and incidentally to show the desirability of a wider application of them than is made perhaps even by those who already use them.

For a considerable time I thought the method of closing wounds by tier sutures of absorbable material with a subcuticular suture for coapting the skin was the acme of perfection. Now, with rather rare exceptions, I never use a stitch in either the skin or subcutaneous tissue, but use adhesive plaster instead. The plaster is applied in strips about one-fourth of an inch in width, after the skin has been thoroughly dried. No more strips are used than are necessary to maintain perfect coaptation. If desired, they may be left on for two weeks. Some cases, as for instance operations for mammary carcinoma, will require either two or three tension sutures in connection with the adhesive strips, or instead the wound may be closed throughout with subcuticular stitches of catgut. Again, in rare cases a few stitches may be needed to obliterate dead spaces in very fat subjects. In these

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cases, however, it is usually possible to obliterate the dead spaces by placing strips of adhesive plaster over rolls of gauze placed parallel to the wound. I regard the use of adhesive strips in the closure of wounds as a long step in advance of the buried absorbable suture, which in its turn was a long step in advance of the older methods.

To-day, with the combined use of buried absorbable sutures and adhesive strips, results may be obtained which are far superior to those following the use of through-and-through sutures. Save in cases where much tension is necessary to maintain coaptation in the presence of infection, a suture through the skin is unnecessary, and will soon come to be considered as an evidence of want of skill or care on the part of he who places it.

Tension alone of the skin or subcutaneous tissues is not a sufficient excuse for placing a suture through the skin in a case where the avoidance of a scar is particularly desirable.

Superficial abscesses are less frequent with buried than with through-and-through stitches; they are least frequent when adhesive plaster is used and all stitches are avoided. There are three reasons why this is true: 1. There is better drainage when no stitches are placed. 2. The coaptation is more perfect. 3. Trauma is avoided. It may seem paradoxical to say that the drainage is better with the method which gives the most perfect coaptation. Nevertheless this is true. The blood which collects beneath the skin easily presses apart the elastic skin edges between the plaster strips and is immediately taken up by the gauze, and as soon as the oozing stops the skin again falls into apposition. I frequently remarked that the dressing over wounds closed with adhesive strips, other things being equal, was much more blood-stained than the dressings over wounds closed by suture. Perfect coaptation is, then, not incompatible with drainage. Indeed, the principal objection to the subcuticular stitch is that by its use the wound is closed

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too tightly. When suppuration does occur in wounds coapted by adhesive plaster it is of much shorter duration and less extensive than when stitches are used. By the use of adhesive plaster the scar is reduced to the minimum.

Another advantage of the adhesive plaster is that its use takes so much less time than does the placing of sutures by any method. The objection may be urged that there is danger of the plaster not being aseptic. There need be no fear on this score, however, as the plaster may be kept ready for use in an air-tight receptacle in the presence of formalin, which will thoroughly asepticize it without in the least diminishing its adhesive properties. I have used many of the rubber plasters in the market, and save that some adhere a little more strongly and promptly than others, I have found no difference in them. Plasters with much resin in them may irritate the skin.[1]

In operations about the face the avoidance of scars is particularly desirable. How common is it, for instance, to see the face of a patient who has been operated on for hare-lip terribly disfigured by scars caused by the stitches or pins used for purposes of coaptation. The cases of hare-lip requiring the placing of a stitch which shows are exceedingly rare. Subcuticular sutures with adhesive plaster is all that is required, and the results obtained will be found to be infinitely more satisfactory. Stitch-abscesses are a menace to life in a very slight degree only, but in however so little they increase the danger of operation this were a sufficient reason for doing all in our power to avoid them. In many cases the strongest reason for preventing suppuration of this kind is because it decreases the strength of the wound. For a through-and-through skin stitch, or a subcuticular stitch to be the cause of suppuration extending to the

1. Folding both ends of each strip of plaster so as to produce a hem, as it were, free from adhesion, will materially facilitate the removal of the strips. I am indebted to Dr. H. A. Duemling of Fort Wayne for this suggestion.

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deeper structures is not an extremely rare thing. Generally speaking, animal sutures, with our present knowledge of preparing them, are not, as a rule, to be used in the presence of infection. This necessitates the use of non-absorbable sutures which can be removed when they have fulfilled their purpose. Such a necessity sometimes arises in operations for hernia. It can be met by placing the sutures mattress-fashion, and bringing the ends out through the skin and fastening them there by using perforated shot and buttons.

This method reduces the number of skin punctures to a minimum, and does away with the dangers incident to the constriction produced by tying the sutures in the ordinary way. Another plan which has been found to work well is the use of a running stitch of non-absorbable material, each end of the thread being fastened by the shot and button. The objections to this later form of suture are two: 1. Its removal is painful. 2. If suppuration does occur it will be more extensive, other things being equal, than with an interrupted suture. When either of these methods are used for the deep structures the superficial ones are coapted by the adhesive plaster. Still another plan which I have found to work well where for any reason non-absorbable material was deemed necessary for the deeper tissues is to place the stitches as though the usual figure-of-eight stitch were to be used, but instead of completing the figure by tying, and thus coapt the skin, each end of the thread is fastened by the shot and button at a short distance from the margin of the wound. The skin is then brought together with adhesive strips. No matter how fat the subject, the proper placing of this stitch will not only result in effectually coapting the deep structures, but will also prevent the formation of a dead space between the deep structures and the skin, and with a minimum of constriction and trauma, both of which are particularly to be avoided in fatty tissue.

Save in intestinal work, I believe that non-absorbable

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material should not be used for suture with a view of allowing it to remain permanently. Personally, I have not for five years seen a case in which I thought such use necessary or advisable. Within this time I have operated on several large scrotal and umbilical hernias. I said in an earlier part of this paper that animal sutures were usually contraindicated by the presence of infection. This, I think, is correct, and yet I have used them under these circumstances, with the most gratifying results. In a case in which a large part of the half of the lower jaw was resected together with a portion of the cheek for an infected carcinoma I closed the wound throughout, except for one silkworm-gut stitch next to the drainage tube, with subcuticular catgut stitches and adhesive plaster, with the result that the scar was reduced to a line in width, save at the exit of the tube and the location of the through-and-through stitch. The necessity for drainage for other than infectious fluids is not a bar to the use of animal sutures.

In the presence of infection necessitating drainage there is especial reason for avoiding sutures particularly to coapt the skin or subcutaneous tissue. In such cases only such sutures should be used as are absolutely necessary to coapt the deeper structures, and the superficial ones should be coapted by the use of adhesive strips. Even these deeper sutures can be avoided in many cases wherein they are now, by the majority of operators, deemed necessary. To illustrate, an amputation of the arm seldom, if ever, requires a suture, and, as indicated above, they are especially to be avoided in such operations done through infected tissues. Court plaster, collodion and cotton and collodion alone are inferior to aseptic adhesive plaster. The reasons for this opinion, it seems to me, are too patent to require their being given.

CONCLUSIONS.

In conclusion, I desire to emphasize the following points:

1. The use of sutures should be avoided save where

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necessity demands their use. Many wounds, in which sutures are now commonly used, may be coapted more perfectly, more speedily and more safely without the use of sutures.

2. Tension and moisture are the only conditions making sutures necessary.

3. When sutures are necessary buried absorbable sutures should be used in all cases where there is no infection.

4. The necessity for drainage does not contraindicate the use of adhesive plaster for purposes of coaptation.

5. It is doubtful if the use of non-absorbable suture material should ever be used with a view to its remaining permanently.

6. Non-absorbable sutures are not necessary nor advisable save in intestinal work and in the presence of sepsis.

7. In those cases in which non-absorbable sutures are necessary that method of applying them should be chosen which will subject the tissues to the least possible trauma, produce the fewest possible avenues for infection through the skin, and permit of their being removed when they have fulfilled their mission.

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DISCUSSION.

DR. JOHN E. SUMMERS, JR., Omaha—When I commenced the practice of medicine more than twenty years ago I used plaster in the open treatment of wounds. With our modern methods of the treatment of wounds we discarded plaster, and we discarded a very useful material, but probably it was a good thing, because it taught us to be more cleanly; but as plaster is made to-day there is no doubt that it can be used, and there is no question that thoroughly clean work can be done with it. The technic which Dr. Porter brings to our attention seems to me to be ideal. For the repair of wounds we have two or three things to consider: we must have accurate hemostasis; we must have exact coaptation of the edges, and from the bottom to the top the wound must be held together without tension. If this can be accomplished, we have done all that is necessary, and the very best things that can be done.

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This can be accomplished in the superficial wounds always, but in the deep wounds I doubt whether it can be done, and as the Doctor has suggested, it may sometimes be advisable to use some kind of a stitch as an aid to the result desired. I would hesitate very much to rely entirely on plaster strips for the coaptation of abdminal wounds, except in selected cases where a normal convalescence was assured. Now in an abdominal operation of any seriousness there is a certain amount of shock, with moist skin, and after the wound has been dressed the adhesive plaster may loosen and not keep the edges together. For this reason I hold that it is unwise to use plaster in wounds of that kind. However, when we do use adhesive plaster, I think you should have a pretty definite idea of how it should be applied, and judging from the Doctor's drawing, he does apply it as I think it should be. Both ends of the plaster strips should be applied at reasonably fixed points. Below they should go over the crest of the ilium, and they should cross over the inner border of the latissimus dorsi muscle. Then you have two points as nearly fixed as they can be gotten. If it is applied in this manner, then you can be sure if distension occurs that the plaster will hold.

Dr. Herman E. Pearse, Kansas City, Mo.—The tendency of us all is to do too much suturing about wounds, too little of which is really effective. We must recognize the fact that one of the most prominent steps in surgery was taken when suture material was perfected. It seems to me that the plan that the Doctor advises of the surface approximation of wounds, and if necessary the absorbable suture below the surface is a most excellent one. It has never seemed to me safe surgery to depend entirely for the closure of abdominal wounds on absorbable sutures. It may be that one or two unfortunate instances have made me more cautious in this regard. I remember particularly one old lady, quite advanced in years, where healing was particularly slow, in which the absorbable suture was used, and through some defect in the suturing or suture material the wound gave away on the fourth day, and I was chagrined to see three or four coils of intestines roll out. These were returned, and a through-and-through suture applied, and the patient made an uneventful recovery without hernia, and yet I suspect that many a case has this accident beneath the skin. If the damage was done in the first few days, it might never be suspected by the surgeon, and there would perhaps be a sufficient union for the surface to heal, and leave the inner layers of the abdominal wall separated. It seems to me that this method is better than suturing for wounds on the extremities and about the face. I think that the through-and-through suture of silkworm-gut should be used in abdominal surgery in addition to the superficial suture. At least one should use a

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few such "splinting" silkworm-gut sutures in connection with the adhesive strapping and the absorbable sutures.

DR. ANDREW W. MORTON, San Francisco—I have been very much interested for a considerable number of years in the use of adhesive plaster for the closure of wounds, and I do not think we should let this speaker go on record without a challenge. In the first place the Doctor speaks of closing wounds in the abdominal cavity by means of adhesive plaster, without using any suture to close the fascia. We all know very well from our experience in abdominal surgery that the principal thing that gives strength to the abdominal wall is the fascia, and if it is not brought together by means of stitches, how can it be brought together? The adhesive plaster simply pulls the outer structures together, and the fascia, which gives strength to the abdominal wall simply disappears by retraction. You can simply make coaptation of the skin by means of the adhesive plaster, but not of the deep structures, and if there is one thing that we are taught in surgery, it is not to leave any dead spaces. You take any deep wound and it is practically impossible to prevent dead spaces occurring by means of the adhesive plaster. I speak on this subject because I find that there is one thing that we are prone to do with any new subject, and that is to go to the extreme. Now, in closing superficial wounds, we have long since learned that it is an admirable method, because, in that condition we generally have a very low vitality of the structures, and on account of the amount of pressure which is necessarily brought to bear in closing these wounds by a stitch, which produces tissue necrosis—always an unfavorable condition. Another thing in regard to the use of the stitch, and the principal reason why the stitch is so often objectionable is on account of infection. In my opinion there are only two reasons for getting infection: First, not being aseptic, and second, surgeons all over this country in tying a stitch, put too much strength on it, and as a result they get tissue necrosis, which invites infection. To-day there is not the objection to the use of buried catgut sutures that there was a few years ago. I can see no objection to the use of the adhesive material, if you use the absorbable catgut suture, or chromatized catgut, to close the deep wounds. There is only one form of adhesive plaster with which I have had a large experience, and that is the form prepared by oxid of zinc. The first I used was the other, and I found that eight or ten days after the operation there was great danger of excoriation of the skin, which is naturally painful and dangerous. This excellent paper brings our attention to one of the prominent things in surgery, but I believe that the Doctor is using it in cases where it is hardly justifiable.

DR. WILLIAM M. PERKINS, New Orleans—In many wounds

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perfect union may be prevented by maceration of the tissues or by slight hemorrhages either subcutaneous or appearing between the stitches. Sutures have a distinct hemostatic function which can not be satisfactorily performed by adhesive strips. The perspiration, when confined by an impermeable covering, may cause sufficient maceration to greatly favor superficial infection. Germs like heat and moisture. Asepsis is a relative term; practically no wounds are germ-free, but we aim to limit the numbers of pathogenic micro-organisms and to secure conditions unfavorable to their development. It is often advantageous, especially in warm climates, to afford free ventilation to the gases under a dressing. Adhesive plaster prevents this to some extent. The whole theory of the use of *absorbent* gauze and cotton is based on the necessity for having a dressing which will keep wounds free from moisture and allow for the circulation of gases. Adhesive plaster strips are an excellent means of closing many wounds, but are by no means universally applicable.

Dr. Miles F. Porter, Fort Wayne, Ind.—I can not consider it possible that my paper was misunderstood by very many, as it seems to have been by this gentleman. I stated that you could not use adhesive plaster where there is tension, and there is tension where you coapt a hernia wound. I have used the adhesive plaster for the purpose of coapting wounds that could be coapted by it, and not for the purpose of deceiving myself. I stated that wherever there is tension, it must not be used. The method I ordinarily employ in abdominal wounds is to use the tier sutures of absorbable catgut, sterilized, for the deep structures and plaster for the skin. I have never had occasion to be sorry for it, although in some cases I have had occasion to be sorry that I made the operation, as in such cases as those related by Dr. Summers. Vomiting with opening of the wound, however, will occur when non-absorbable sutures are used as often as when absorbable sutures are used. I agree with Dr. Summers that it is advisable sometimes to employ stitches of nonabsorbable material. In regard to the moisture that you have when you coapt the skin with adhesive plaster, I do not know how it would be in this climate, but I have closed over one hundred wounds in this manner without trouble from this source. Beneath the plaster, of course, there is a small amount of moisture which comes from the follicles.

When you come to remove these little strips of plaster, oftentimes it is hard to pick up the end, but if you will just take the strip and turn in a quarter of an inch on each end before applying it to the wound, then you can take hold of each end very easily. Now regarding the treatment of abdominal wounds. I use short strips of adhesive plaster, three inches in length and one quarter inch wide, to coapt the skin, and over

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the dressing I place long, wide strips of adhesive plaster that reach three-quarters of the way around the body. My strips of adhesive plaster are put on solely with a view of keeping the skin and subcutaneous fat coapted, and you can not keep anything else coapted in that manner. If the man who has made many operations on the face using through-and-through sutures will try the subcuticular stitch with adhesive plaster, I warrant you he will never go back to the old method.

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REPORT ON OPERATIVE TREATMENT OF GRAVES' DISEASE.

T. C. WITHERSPOON, M.D.
ST. LOUIS.

CASE 1.—In April, 1895, a patient presented herself for treatment suffering from a well-developed Graves' disease. Exophthalmia was not marked, but the cardiac frequency and the thyroid enlargement was present. Tremor, loss of flesh and bowel symptoms made the case one of undoubted Graves' disease. She submitted to partial thyroidectomy under chloroform and made a nice recovery. Two years afterward I received word from her through a friend that she was well and strong, able to attend her duties and suffering none of the former symptoms.

CASE 2.—In 1898 a patient was sent me who suffered from a similar condition. She was 52 years of age, very thin, having lost a great many pounds of flesh, suffered from recurring diarrhea and was very weak, practically bed ridden. The pulse rate was 140 to 160, the thyroid very large and vascular, exophthalmia not marked. The right lobe being the larger was removed under cholorform anesthesia. There was very free hemorrhage from the inferior thyroid, and on account of pulse weakness she was given a pint of saline under the skin while on the table. This was repeated in two hours. Within six hours the pulse had regained the rate and quality which characterized it when she went on the table. During the night it began to increase in rate and lose in strength. There was no response to stimulants and in forty-eight hours she died.

CASE 3.—The third case on whom I operated was a woman 59 years of age. She was born in Missouri and had lived in St. Louis for many years. Her first visit to me was in September, 1899, at which time she suffered from very evident Graves' disease. The goiter was well marked, the right thyroid lobe being the larger, there was moderate exophthalmia and the pulse rate was from 130 to 150. She had lost a good deal of flesh, the skin was always moist because of an exhausting sweating, the nervous symptoms were marked, heard

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strange noises and had ideas of persecution; the respiratory movements were extremely shallow and pectorals wasted, bowels were diarrheic, urine contained casts and albumin, and was slightly increased in the 24 hour amount. A diagnosis was made of chronic interstitial nephritis associated with Graves' disease. I was of the opinion that her general condition contraindicated so extensive an operation as partial thyroidectomy and advised a double sympathectomy. September 10 the three ganglia on the right side were removed and on the 21st those of the left, under chloroform. The healing was primary and shortly after the second operation the pulse showed improvement in quality and rate. Her general condition was likewise benefited, the bowels ceased to become overactive, the sweating stopped, the weight improved. December 14 she had so far recovered that she took a trip into the country to take advantage of the fresh air and outdoor life possible there. From her son I learned later that in the latter part of the month of February while out riding she became chilled and died two hours afterward. He states the pulse rate had become normal before her death, the exophthalmia had almost entirely disappeared and the goiter fully half. Her mental condition was normal and the nervous symptoms had cleared up to a large extent. What part was played by the nephritis in her sudden death can, of course, be only a matter for conjecture, but it must be admitted the operation was followed by decided relief.

During the last twelve months I have had a series of six cases presented me for operation in all of which partial thyroidectomy was performed. They were as follows:

Case 4.—About the first of May, 1902, S. S. was sent to me with a pronounced exophthalmic goiter. She had been under treatment without benefit and an operation was advised. She was born in Germany, came to St. Louis when 16 years of age, and has lived here since, a period of 23 years. There is nothing of note in her family history. At the time of her first pregnancy the thyroids became larger and remained so afterward. There were no symptoms of Graves' disease until about a year before I first saw her. At that time she noticed an increased nervousness and rapid heart action. At the time of the examination she had a well-marked exophthalmia and stated that the intensification of the symptoms dated back five months, at which time she became pregnant. Her general condition indicated a process of only moderate severity. There was not a great loss of flesh and her appetite and strength were fair. She did suffer from a marked degree of nervousness, however, and insomnia was distressing. The pulse rate varied from 100 to 120, exophthalmia marked, Graefe symptom present, the

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right thyroid lobe the larger. Other symptoms were present, as tremor, sweating, headache, recurring diarrhea. She had had attacks which resembled asthma for years, and these had been intensified.

May 6 the right lobe was removed under local anesthesia. After finishing the operation and while putting on the dressing she had a slight tetanic attack, general in character and accompanied with a loss of consciousness for the moment. No ill effects followed this, and after being placed in bed she felt quite easy, except for a mild degree of burning in the area of the wound. This lasted only two hours and disappeared. The improvement in her condition was apparent in two days, and within the next week she was fairly free from nervousness. The pulse dropped to 74 in forty-eight hours. There was rapid improvement in the exophthalmic condition also. During the remaining time of pregnancy she showed only such symptoms as are characteristic of the period. She was delivered at full time of a healthy child, making a nice recovery herself. At the present writing her condition is quite normal.

CASE 5.—Mrs. B. came to me in June presenting the following history and conditions: Born in St. Louis, lived here all her life, 35 years, parents were German, she was married some years, but had no children; examination revealed no pelvic disturbance. Gives no family history which could shed light on her trouble. About nine months before coming to me she noticed the first marked symptoms of her present disease, although for some months prior to that time she had noticed an increased nervousness and a tendency to tremble when using the hands. I found on examination well-developed thyroids, larger on right side, pulse varied from 120 to 130, exophthalmia marked and Graefe and Moebius symptoms were demonstrable. The other symptoms were present, tremor of the hands, diarrheas, sweating, loss of flesh, sleeplessness, easily excited, headaches, dry hair coming out in rather large quantities. The right vessels gave both a distinct bruit. An interesting feature was the pronounced prominence of the left eye.

The right lobe was removed under local anesthesia and betterment of the condition immediately followed. At the present time all of the old symptoms have disappeared, including the exophthalmia. She has gained in flesh and feels well.

CASE 6.—In July I removed the right thyroid lobe of a patient in one of the city institutions. She presented the usual symptoms and had in addition a movable right kidney and slight uterine prolapse. After the operation she made a rapid recovery, sleeping well, no tremor and gaining in strength. After leaving the institution I lost track of her.

CASE 7.—Mrs. W., age 62, born in Switzerland, lived in St.

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Louis eighteen years, was sent to me in July for an operation. There was no family history of importance except that a daughter of 36 years of age has at the present time a simple goiter. She had a goiter herself for twenty years, during which time there was no indication of trouble from it. The symptoms of Graves' disease dates from the time of the death of her child three years ago. This daughter died of tuberculosis. In January, 1902, she suffered an attack of pneumonia, from which she did not fully recover. Effusion into the left pleura followed it and on May 17 three pints of this was removed. Again on the 27th this was repeated, removing the same amount. The physician in charge at the time reported on the character of this fluid, stating it was not purulent nor bloody. The expectorate was likewise examined and found to contain no tubercle bacilli. At this time the symptoms of Graves' disease became very pronounced. The tremor marked, muscular weakness with emaciation sufficient to cause her to remain abed, insomnia, emotional perturbations, pulse varying in rate from 135 to 160, and frequent diarrheic attacks. The exophthalmia was not readily noticed unless attention was called to it.

The right thyroid lobe was the larger, and this one was removed July 20. It had grown downward into the chest behind the sternum and was adherent to the trachea for a short interval. The vessels were very friable and the forceps pinched through the inferior thyroid during the operation and bleeding became very active. This necessitated a haphazard catch, which included the inferior (recurrent laryngeal) nerve. Immediately a fluttering vocal cord was the result. In tying the vessel after stopping the hemorrhage it was carefully separated from its surroundings. The voice returned very slowly afterward, never to its normal quality. A pneumonia was set afoot, which appeared on the fifth day in the left lung, the seat of the former attack. Eventually this subsided in part and the patient began to improve. A careful examination still failed to reveal tuberculosis. In six weeks the nervous symptoms had nearly disappeared and the rate of heart action was between 90 and 100. There was a slight, constant fever and cough and the fluid reaccumulated in the side. On aspiration this was found to be purulent. An operation was strongly advised, but refused until late in October. By this time she had lost the flesh gained just after the operation on the thyroid and was very weak. The process had extended to the lung and a large quantity of stinking pus was being expectorated constantly. A portion of rib was removed under local anesthesia and a drain established. She never rallied, however, and died about Christmas last. There was a complete disappearance of those symptoms which were distinctly characteristic of the Graves' affections before her death.

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CASE 8.—A widow, aged 44, born in Germany, came to St. Louis 16 years ago. She has one living child healthy. She gives no history of former trouble which could bear on the present trouble except that 18 years ago she contracted a venereal disease from her husband which confined her to the hospital for several months. The cervix of the uterus is entirely gone and a small opening in the midst of scar tissue is the os uteri. Menstruation is normal except scant in amount. She gives no history of syphilis. Her pulse varied from 95 to 110, some degree of exophthalmia, goiter goose egg in size, the right lobe the larger. A fine tremor, muscular weakness, diarrhea, sweating, nervousness, sleeplessness, headaches were present. I removed the right lobe of the thyroid in September. The pulse rate became normal after the operation, the general condition improved and the tremor left. She still suffers, however, from headache, fullness in the throat and complains of weight in the pelvis. This, I believe, is due to the uterine condition.

CASE 9.—Just operated on. Patient is 29 years of age, born in Kansas, and has lived in various parts of the country during the last ten years. Of herself she writes the following history, and because of its exactness I give it in full. Rather anemic looking since fifth year, scrawny shoulders and small arms. All through life frequent headaches in forehead. In sixteenth year moved to Colorado, living in altitudes of from 6,000 to 9,000 feet, where was employed as a railroad clerk for three years. Felt well greater part of the time. Eyes would occasionally become inflamed; riding on trains augmented this trouble. Vision was not impaired for three years after first inflammatory attack. About twentieth year moved to Memphis, Tenn., eyes becoming more often sore. Oculist advised against glasses and used some drops in eye for two months daily. Vision now became impaired, objects blurred, lines of type ran together. Saw another oculist, who fitted glasses, said trouble was flattened cornea. Wore these glasses with some relief for about a year, eyes gradually becoming worse; inflamed with imperfect vision. In twenty-fourth year another oculist fitted glasses, saying the trouble was compound myopic astigmatism with the consequent inflammation. Great relief followed; worn the glasses since with improved vision, inflammation lessened. Past three years has had many spells of aching back of left eye and followed by reddened conjunctiva. About the twenty-fourth year hand became unsteady when writing. During the summer months each year while in Memphis got debilitated and irritable. During the winter of the twenty-fifth year worked all day and until 11 o'clock at night. Kept up by large quantity of alcoholics. In spring of same year, 1899, passed first-class examination for old line life insurance. No enlargement of neck was noted at the time. Pulse was a

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trifle quick, attributed to running up stairs. During the summer became gloomy, brooded over unfair treatment thought she had received at the office where working. Spent month of July in St. Louis, read much pessimistic and agnostic literature. Thought a great deal about suicide, did not contemplate suicide, but the subject was more attractive than others. Returned to Memphis August of the same year in the same state of mind. Friends tried in every way to divert her mind into new channels without success. Again worked hard the fall and winter of the twenty-sixth year. Gradually mind became normal. December, 1899, noticed neck seemed to look too full in front, friends thought it was all right. In winter was tired all the time, sore and ached all over on awakening; very nervous and irritable. Hands and feet became swollen and red, burned and itched when taking exercise. For last three years perspired profusely on slightest exertion. Hands and face would be moist and clammy while those about were dry and comfortable. Did not sweat at night when quiet in bed. Hair became faded and dry, but did not fall out to any appreciable extent. During the summer of 1900 lost much flesh and became more nervous and weak. In the fall some improvement.

About Jan. 1, 1901, noticed rapid heart action and shortness of breath. Remained in bed for a part of February complaining of prostration, nervousness and insomnia. At this time the goiter became quite perceptible. Dr. R. Maury prescribed tr. iodin applications without benefit to the goiter. Massage was then resorted to for a month with no benefit. If anything this last increased the nervousness. The professor of nervous diseases at the Memphis Medical College then prescribed Norwoods tincture of veratrum viride, to be taken constantly and a mixture of hyoscyamus, potassium bromid and chloral to quiet. This latter was taken at bed time for two years. For the remaining time the bromid alone has been used to produce sleep (60 to 100 grs.).

Exophthalmia was noticed in June, 1901. At this time she gave up all stimulants, as they caused a sense of weakness and she had to go to bed after taking them. Later in same summer went to Lake Superior for a visit and improved remarkably, gaining 18 pounds. In fall relapsed into old condition on returning south. Complained at this time of having both knees give away while walking, causing her almost to fall at times. Arms and legs became numb after resting in one position for a while. Last summer spent at Put-in-Bay, but an exhausting diarrhea prevented improvement.

In fall went to Colorado, where nervousness and rapid heart increased and mental condition became worse than ever. Had maniacal spells, screamed, tore clothing and refused to remain in the room with any one. Physician in charge gave

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thyroids and strychnin, and if anything the symptoms were intensified. Pulse was frequently as high as 150 and felt like a pile driver in the neck. Thyroid increased in size. Took 400 grains of bromid in two hours to quiet. Later returned to the chloral mixture and a tonic. During the last three months suffered from alternating diarrhea and constipation. Appetite fluctuated from a craving for food to a distaste for it. Limbs twitched in bed and insomnia continued. Sore around body and hung clothes from shoulder; temperature of 99 to 100 in the late afternoons. Has a cough which developed in December, 1901, and has continued more or less ever since. At menstrual periods the gland seems to become turgid and causes a sense of choking from pressure.

The only family history which could bear on this condition is on the mother's side. She had asthma until her sixteenth year, always had an affection of the right side of the mouth and jaw. Right lobe of thyroid slightly enlarged and had been so from childhood. Never had the other cardinal symptoms of Graves' disease. Mother of seven children, three died in infancy; one son and three daughters are living. Son as a child suffered from nervous twitching, is now 40 and healthy; daughter, aged 32, has writer's cramp at present, always nervous. Other daughter always free from nervousness. Mother in good health at present.

July 15, 1903.—This patient is in better health than for some time. Exophthalmia gone. Pulse 80 to 90.

These cases of Graves' disease have been in the past most unsatisfactory to treat. Nearly every effort to bring about permanent relief has been fruitless. We have all seen temporary benefit follow the administration of different remedial agents, and have been at times tempted to believe that much of permanent character had been accomplished, only to be disappointed later when, after losing sight of the patient for a while, they would return in a more deplorable condition than ever. Failure in this disease has, as in many other maladies, led to the adoption of a host of remedies for its cure.

It is exceedingly interesting to follow the views of the various writers of the different decades on the subject, and note the changes in the methods of treatment. We read of the disease being a dyscrasia, then, again, a blood impoverishment expressing itself by changes in the thyroid, eyes and heart; later the opinion of alimentary intoxication, a sympathetic disease or a patho-

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logic condition of the central nervous system located in the area of the pons or medulla. Of the recent authoritative writers Moebius adheres to the belief that the seat of the lesion is in the thyroid gland, while Kocher, of Berne, considers the thyroid condition an expression of a central lesion located in the cerebrospinal axis. Mention should be made of the work done by Gley, of Paris, showing a disturbed parathyroid relation with the thyroid as a possible cause of the disease symptoms. As from time to time new light has been shed upon the subject, bringing modified ideas of its pathology, the methods of treatment have accordingly been modified or changed altogether. Iodin, strophanthus, veratrum viride, bromids and chloral, galvanism, thyroid extract, adrenalin, sodium phosphate, sodium salycilate, dietetic regulation, massage, the serum of thyroidectomized goats, the flesh and milk of these animals, and lastly, various surgical procedures, have each been advocated as most helpful.

Naturally, the question arises, what are we to do for, how are we to relieve this class of patients when they come to us for relief? Is there an underlying cause for the condition which can be attacked alike in each case, is there a procedure which could become universally applicable? In the light of our present knowledge we can not hold to too strict limitations, though no doubt were the exact nature of the disease known some rule of action would become applicable to all cases. At the present time a certain degree of empiricism must enter into the treatment; our conduct toward these cases must rest to a large extent on our experiences in the past. We must notice where the internist obtains good results, and weigh carefully the data he presents; likewise have we to consider the surgeon's side of the question, and noting here success and there failure, obtain an explanation of the different results by the different manners of operation, and the individual characteristics of the patients.

I present here the results which I have obtained in

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cases in which internal medicine failed to give relief. The outcome has been very satisfactory to me, and has helped very materially to lead me to the belief that these cases are eminently surgical. Since reading Kocher's article, this belief has been confirmed, and I feel enthusiastic in supporting proper surgical methods for the relief of Graves' disease. Of course, do not understand this to mean that I advocate operation in every case, regardless of all conditions, local or general. In the first place, we must be governed by those rules which are followed in advising operation on any part of the body for the various conditions which fall to the surgeon's hands. In the second place the symptoms which characterize Graves' disease must be given due consideration, and proper value placed on the conditions which characterize each individual case.

A number of surgical procedures have been proposed. The injection of agents into the gland which tend to destroy its secreting power is dangerous, and should never be resorted to.

Ligation of the thyroid arteries to reduce vascularity of the gland has a warm advocate in Kocher. This method was recommended by Woefiler for the common goitre, but Kocher put it to use in the exophthalmic variety. Rehn, Trendelenburg, Rydygier, Wilmers, Reinbach and Mikulicz have reported cases treated in this way. Ligation of the superior thyroid is relatively easy, but the inferior can not be gotten at through an incision in front of the sternocleidomastoid, except by luxating the gland upon the surface, in many of the cases. In selecting the vessels, attention will be paid to the amount of vascular degeneration of the different parts of the gland. It is rare that the whole gland is alike affected. Those vessels are ligated which best control the vascularity. The operation is simpler than removing the lobe, and is to be recommended in those cases where the symptoms remain intense after resting the patient. Later, however, this procedure should be supplemented

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by a partial thyroidectomy in the large percent of cases. The initial ligation always renders the removal of the lobe easier than where this is done primarily.

Unquestionably, the operation which gives the greatest degree of satisfaction is the removal of the most involved lobe of the thyroid gland. Very frequently this is the right. Why this should be so is difficult to understand. Many explanations have been given, but none satisfactory. Two incisions are to be recommended, one in front of the sternocleidomastoid parallel to its anterior border, and the U-incision recommended by Kocher with the convexity over the sternal notch. Kocher recommends the latter because it allows easy access to the median line, where after separation of the muscles which lie upon the trachea the thyroid lobe can be readily reached. This avoids cutting any of the muscles of the neck. The scar is low and not readily seen. Personally, I prefer the incision anterior to the muscle edge. The length need never be more than 4 inches, and it allows the least bloody handling of the gland. The one objection to the incision is that it necessitates the cutting of some fibers of the sternothyroid or the sternohyoid. This is inconsequential, for the fibers of these muscles run nearly enough parallel to allow of separation directly through their bellies, and only a few fibers of the one or the other have to be cut at the ends of the incision. This opens the field perfectly for the largest goitre I have had to deal with. The scar is small and located in an anatomic position which to some extent renders it less apparent.

There are some precautions to be mentioned. The capsule of the gland is usually adherent to it, thickened and very vascular. In separating it from the enclosed gland a very considerable amount of hemorrhage follows. This is avoided to a certain extent by ligating the superior thyroid artery first. Just under the muscles, coming from above and entering the top of the gland, this vessel is easily found. It frequently enters as several

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branches, and care must be exercised to ligate all of these if the main trunk can not be gotten at. The next difficult step is securing the inferior thyroid artery. This can only be done after raising the gland from its bed and carrying it toward the median line. The whole vascular apparatus is so friable that it is possible that some vessels of size be torn in this separation and bleeding hard to control. To render this less difficult, bring about very careful, gradual luxation, catching each bleeding point with a forcep as it occurs. After reaching and ligating the inferior thyroid all forceps can be removed, as these two vessels supply the area with blood. It is wise to ligate the large veins, however, for, though forcipressure suffices to check their bleeding for the time, their lumens are apt to open later and allow of a large clot formation in the wound. A very difficult point in the operation is catching hold of the highly vascular gland with any instrument with which to hold it. Vulcella forceps tear out and cause very serious hemorrhage. I find it expedient after exposing the anterior surface of the gland, to pass heavy mattress stitches of silk from side to side, and when these are tied the forceps catch better, and bleeding does not follow any little glandular laceration. Great care must be used in avoiding the recurrent laryngeal nerve, while dealing with the inferior thyroid.

This operation should always be performed under local anesthesia. Kocher recommends a 1 per cent. solution along the line of skin incision. I prefer a 0.125 per cent. solution. It is incorrectly stated that there is no pain after reaching the deep structures of the neck. These patients, very nervous and strung to a high pitch by the thoughts of the operation, do complain of pain in handling the deep structures, and are more readily controlled when the whole area is infiltrated. Eucain, being non-toxic when used in reasonable amounts, can be freely injected in very dilute solution. Infiltration is made between the gland and its capsule just ahead of

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the separation. I have never required more than ½ gr. of the drug to complete the entire operation. It is wise to reinfiltrate the skin before attempting to stitch the wound. All ligatures are made with a fine silk. I have not drained my cases. At one time there was a fear that the secretion expressed during the operation into the wound, and that formed and given off from the cut surface afterward were dangerously toxic. Drainage allowed these to escape, and therefore was recommended. There is some danger from the bleeding into the closed wound afterward, this causing suppuration and septic symptoms. A twelve to twenty-four hour drain is allowable when there is likelihood of much oozing.

Socin proposed the excision of enlarged nodes. This is not to be recommended, as it is incompetent and bloody, and many thyroids are uniformly degenerated. The Mikulicz operation, proposed for the ordinary parenchymatous goitre, has been resorted to in some cases of exophthalmic goitre with double enlargement. This operation consists in exsecting a portion of each lobe. This is too bloody to be recommended. A ligation of both superior thyroid arteries and a later removal of one lobe will accomplish more, and is more readily performed.

Jaboulay's operation of exothyreopexy is not to be recommended. The process of healing is too tardy, and the benefit not as assured as by either the ligation of the vessels or the partial removal of the gland. I do not know that this method is being adopted by any other than Jaboulay.

Lastly, I shall mention the operations on the sympathetics. Surgery of the cervical sympathetics had its initiative with Alexander, of Edinburgh, who resected the superior ganglion on both sides for epilepsy. This was in 1889. Jonesco, in Aug., 1896, resected the superior and middle cervical ganglia for Graves' disease, and the operation has since borne his name. A Russian

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surgeon by the name of Barocz proposed the operation as early as 1893. In my one case for exophthalmic goitre the operation was done in two sittings. The incision being made along the posterior border of the sternocleidomastoid. It can be readily done under eucain anesthesia.

Whatever the operation performed, general anesthesia should not be used. The myopathy and the vaso motor disturbance makes it exceedingly dangerous. This caution against general anesthetics holds also where the operation is for some other purpose than to relieve the symptoms of the exophthalmic goitre. Strange to say, the condition which follows operation upon these cases under general anesthesia is alike, whether done for the relief of the goitre or for other purposes, indicating that handling of the gland is not an explanation for it. I recall a case in which I used general anesthesia in the currettement of a bleeding uterus, following an abortion, in which all other means had failed. For two days following the operation the pulse rate was between 190 and 210. Eventually, she recovered from the immediate danger, only to succumb to an enteric attack later.

An objection to the use of cocain based upon the report of Riviere and Edmunds is not well taken; they assert the symptoms of cocain intoxication correspond to those of Graves' disease. Even if so, I can not agree with those who consider a unity of action in the two cases. However, in using eucain anesthesia, the amount of the drug is too small to produce additional intoxication.

The results from operative treatment of Graves' disease have been, on the whole, gratifying. Naturally, they vary somewhat with different operators, and also with the character of operation. Mortality has been surprisingly low; in 1896 Starr gave a record of 190 cases collected, with a mortality of only 12 per cent. Kinnicut the same year presented the record of 187 cases with 7 per cent. mortality. Schulz records 20 cases with-

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out mortality. The most valuable record of the present time comes from Kocher, of Berne, in which he had four deaths in 59 cases operated upon by himself. In these, the operation could not be held entirely responsible. Ligation had in the past a larger per cent. of mortality than thyroidectomy, but there should be no reason for this at the present time. In the group of cases I present, the one death was undoubtedly the result of having given a general anesthetic.

The relief of the symptoms of Graves' disease has been gratifying. A fair average for the cures from operative procedures during the last ten years may be stated as 60 per cent.; of decided benefit 15 per cent.; and of deaths and failures, the remaining. In the 7 cases surviving the partial thyroidectomy performed by myself, the symptoms in all practically disappeared. Betterment was noted in all but one within forty-eight hours. The continuation of a high pulse in Mrs. W. was due to the pulmonary complication. Nervousness in each case disappeared almost completely before leaving the hospital, with the exception of the last case operated on but a few days since.

In one of my cases the nerve was injured by being grasped by forceps, and though the ligature was put about the vessel afterward, in such a manner as to avoid including the nerve, the voice was never quite normal afterward. Two of the cases had a slight tetanic convulsion immediately following the operation, but recovered as speedily as the others, without apparent ill effects. Mrs. B. had an interesting condition in that the right lobe of the thyroid was the larger, while the left eye was most protuberant. Exophthalmia in her case disappeared entirely after operation. Case S. S. carried her child to full term under a far more comfortable condition than was possible without relief of the exophthalmic goitre symptoms. After the operation certain symptoms may continue for a longer or shorter time before disappearing. The most persistent of these is the

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exophthalmia. In my cases ocular co-ordination was one of the first noticeable benefits. The physchic disturbances which follow, I believe, may be attributed to an infection of the wound in the majority of cases. This is illustrated by my last case. Three days after the operation she sat up, declaring herself better than for sometime. Her pulse and nervous symptoms certainly indicated this. On the sixth day she began to complain of pain in the area of the wound, which was the result of a slight inflammatory reaction. After that she became extremely irritable, taking marked dislike for her nurse. In her case the whole of the left thyroid was removed, with the exception of a small portion of the upper end, containing an apparently normal para-thyroid.

The question arises did the presence of the para-thyroid produce this excitation, or was it septic? The removal of the para-thyroids in animals gives rise to symptoms like those of Graves' disease, but I am at a loss in the absence of the thyroid proper to account for the presence of these bodies producing any such effect.

The character of the gland changes differed in the various cases. Vascular degeneration was apparent in all, but in many there were primary conditions not related to the exophthalmic goitre, and in some, undoubtedly secondary changes, consequent upon the marked vascularity of the thyroid.

As time will not permit a discussion of these differences in detail, I shall have to present them in a later paper.

DISCUSSION.

DR. W. W. GRANT, Denver—I have had no experience, whatever, with the operation for the treatment of exophthalmic goiter. The operation is more particularly appropriate to certain cases of traumatic epilepsy and glaucoma. Kocher, in 200 or 300 operations performed during the last two or three years, has used a solution of cocain. He has abandoned the use of general anesthetics, because of the unsatisfactory results, one of which is vomiting, which may occur during the progress of the operation, and if any surgeon attempts to perform this operation on a reasonablly large tumor, and

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particularly on a vascular one, without due consideration of the difficulties and complications that may arise, he is liable to a rude awakening. I have performed only a few of these operations, but I invariably open the capsule. It is much easier to make the incision through the skin, dissect from the tumor, and then open the capsule. It is much easier to ligate the arteries, and the operation can be done much more quickly; and this is an operation demanding all possible celerity. I had a case two or three months ago, the largest of these tumors that I have ever removed. It occurred in a woman 40 years of age, and tne tumor had existed for twenty years. Whether or not we can explain it, it is a fact that the condition of many of these patients, although seemingly good, is not so in reality. They have but little resisting power. They succumb to the slightest hemorrhage as well as to anesthetics, their condition becomes alarming at times during the most critical period of the operation. After opening the capsule I had no difficulty in ligating the inferior thyroid vessels, but in separating the tissues for the superior thyroid I opened a sinus with the finger and a blood stream came out, which, it seemed, was as large as the little finger. It was quickly arrested, and although but a small amount of blood was lost, it was noticed that the patient was in a state of collapse. I proceeded with the operation, while assistants used restoratives and the patient recovered quickly, and her convalescence was uneventful. I always prepare the patient for such an operation. I insist that the patient should remain in the hospital for three or four days (or a week or more) and use 1/30 of a grain of strychnia three or four times a day. I have found this to be very useful. If necessary, atropin may be administered before the operation as a heart tonic. I have found it very appropriate in these cases. The amount of cocain which Kocher uses is a 1 to 2 per cent. solution, but I have not employed it because I fear its effect on the heart, especially in large tumors. I have used chloroform, but fear general anethesia also.

Dr. Emmet Rixford, San Francisco—Goiter is a disease which produces fearful suffering to the patient, and whether we can cure those patients by operation or not, we are doing a tremenduous service to them, if we can alleviate their symptoms. But the operative treatment is not so simple as it may appear. The problem is an extremely difficult one. Exophthalmic goiter may be said to be of two sorts, primary exophthalmic goiter and secondary exophthalmic goiter. By the latter I mean those cases in which the disease or symptoms supervene in the presence of existing goiter, and prognosis from operative procedure is infinitely better in the latter class of cases. In these cases there is very often an encysted thyroid adenoma, which is the seat of the goiter. The opera-

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tion is much simpler in those than in the so-called primary exophthalmic goiter. It simply requires the removing of the adenoma, if the capsule can be identified. The operation should be undertaken with the greatest caution in those cases in which the heart shows degeneration. Confidence is of the greatest value to such a patient, and he should be made to rest and become accustomed to the surroundings in the hospital, mental as well as physical preparation for the ordeal being necessary. The greatest danger, as Kocher has definitely demonstrated, is the anesthetic. I have seen the greatest trouble from an anesthetic, the heart beating faster and faster until it reached 200, then 300 per minute, and finally became too fast to be counted. These patients perspire tremendously. They do not stand antiseptics well, and they should be used with the greatest caution. They do not stand sepsis well and, therefore, the greatest care should be used to have a perfect technic. I have operated on four cases of exophthalmic goiter, protecting the wound by a piece of sterilized cloth around the neck, and held up by uprights at the end of the table, so that the patient cannot see the hemorrhage, and so that he could not see what was going on. The sight of the forceps and instruments, etc., increases the nervousness of the patient. I employ 1 per cent. cocain as a local anesthetic. I prefer to make the transverse incision where the tumor is not very large, principally because of the cosmetic effects. Women are much more likely to have this condition than men, and the transverse incision can be made very low down and the scar can always be covered by a bit of ribbon. The vertical scar always sticks up above the collar. The incision along the sternocleidomastoid always gives more room and where the tumor is large, it is the preferable operation. I was interested in hearing Dr. Witherspoon speak of opening the posterior fascia of the neck and enucleating the tumor. Kocher speaks of cocain being of assistance. In my last case that I operated on I thought that it was so simple that I could remove it without much of a wound. I did not draw the gland to the middle line, but worked from the outside. I passed the ligature around some vessels and the man indicated that he could talk. The ligature was removed and the man has since recovered his voice. As to the relief of these exophthalmic symptoms, in certain cases, it is wonderful and often immediate. I had one case that had been having from fifteen to twenty passages from the bowels a day. She suffered from profuse perspiration, the sheets had to be changed several times during the night. The patient did not expect to recover; in fact, she preferred to die. Within a week from the time of the removal of the thyroid adenoma she had lost thirty pounds in weight. She had been practically bedridden and unable to walk more than half a block before the operation, but within

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three months thereafter she had ridden a bicycle twenty miles over a rough country road.

DR. J. SHELTON HORSLEY, El Paso, Texas—I think we can not determine the proper surgical treatment of this condition until its pathology has been more definitely settled. There are two theories; one is that the disease is due to morbid impulses originating in the medulla and sent out over the sympathetic nervous system, the excess of thyroid secretion being due solely to these impulses. The other theory is, that the disease is caused by an excess of thyroid secretion in the blood, which acts on the nervous system. We know that in cases of exophthalmic goiter there is nearly always present an excess of thyroid secretion. However, this is not universally true, for some French surgeons have observed this disease in cases in which the thyroid gland had been previously removed by operation and in cases in which it was apparently congenitally absent, or at least so small as to escape detection. These facts have been very well brought out by Dr. Alfred Gordon, of Philadelphia, in a paper in the *Philadelphia Medical Journal* a few years ago. If this first theory is correct, Jonnesco's operation is unquestionably the correct procedure, as it permanently interrupts these impulses by taking out all of the cervical sympathetic ganglia. If, however, the second theory is correct, Jonnesco's operation is clearly inapplicable, and the only logical procedure is excision of the thyroid gland. As these two operations are founded on pathologic theories that are diametrically opposed to each other, it does not seem proper to use indiscriminately either the Jonnesco operation or excision of the thyroid, depending on whichever may be easier performed in a given case.

About three years ago I operated on a case of exophthalmic goiter having all the classical signs and symptoms of that disease. I did a partial Jonnesco operation, removing the cervical sympathetic ganglia on the right side of the neck. I intended removing them on the left side also, but the patient's condition forbade it, as her pulse was about 200 when the right side was finished. The operation was reported in the *Annals of Surgery* about eight months later, as it was one of the first cases in which the Jonnesco operation for exophthalmic goiter had been done in America. At the time of the report, she had improved wonderfully; pulse was 100 and she had gained in weight more than 30 pounds. The swelling in the thyroid, however, had not perceptibly decreased. Soon after this time, the patient began to get worse, and is now in the same condition she was in when first operated on. A second operation for removal of the ganglia on the left side of the neck, though proposed, has been rejected. It seems that cases of exophthalmic goiter may be cured, or at least relieved and improved, by either Jonnesco's operation or excision of the

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thyroid—operations which are founded on entirely different pathologic theories. It has occurred to me, in view of the improvement and subsequent relapse of my case and after reading the literature on the subject, that operation may have the same effect in exophthalmic goiter that is attributed to trephining in epilepsy. In other words, any operative procedure that is sufficiently severe to affect profoundly the nervous system, may result in relief of this disease, just as epilepsy is often apparently cured by simply trephining.

DR. T. C. WITHERSPOON, St. Louis—In regard to the indication for operation in exophthalmic goiter I believe that these cases should first be subjected to internal medication and then, if that fails, we should operate. In regard to the last Jonnesco operation I am not in a position to express an opinion on it. I was not gratified by the results obtained in these cases. I have not done it in exophthalmic goiter but once, but I have tried it three times in epilepsy and in none of the three cases did I secure results that were very gratifying. The one important thing that I want to speak of is the giving of a general anesthetic to these patients. We should not forget that when they are operated on for removal of the thyroid or for any surgical condition whatever they suffer tremendously from the effects of a general anesthetic. I remember a case I had in which the pulse was from 140 to 150, and I gave chloroform to allow of uterine curettement, and her pulse ran up to between 190 and 220, but she ultimately recovered from this condition. A general anesthetic is dangerous, and those who operate under general anesthesia are going to obtain poor results. In the next place those gentlemen who prefer simply to deal with the gland by primarily shelling it out I think are going to regret it some day. You should tie the blood-vessels early. There is but one way to tie them, and that is to get back of the fascia. If you get back of the fascia above the gland and run your finger behind the gland you can separate the carotid sheath and vessels from the gland, and render ligation and separation of the structures easy. I had one case in which a portion of the gland had grown down back of the sternum and another in which the gland was very deep in the neck, so that they are very different in shape and can not be dealt with alike.

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ABSCESS OF THE SPLEEN.

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Abscess of the spleen is rare, and when a case falls into our hands and is operated on successfully, it is worthy of record.

About the middle of May, 1901, I was called to see Mr. A., and obtained the following history:

History.—American, age 74 years, weight 211 lbs. Family history: Mother and one sister died of consumption. Father died of some brain trouble. Previous history: Has had two severe falls, the last one two years ago, from which he never fully recovered. Jan. 10, 1901, was seized with a severe attack of influenza, which completely prostrated him. At the end of three weeks the temperature and pulse were normal. He has never lived in a malarial district and has never suffered from typhoid or malarial fever. Since the beginning of his sickness he has constantly lost in weight.

Present Illness.—Patient in bed, anemic, covered with a cold perspiration, very nervous, anorexia, night sweats, slight constipation. Complains of numbness in legs and feet, slight though constant pain in left thorax just above lower border of ribs. At times he is pressed for breath, which appears to be due to his nervous condition.

Physical Examination.—Temperature normal, pulse 100, weight about 175 lbs., heart's action very feeble, slight tenderness on deep pressure under lower border of ribs on left side, reflexes normal. I thought that his condition was due to the severe attack of influenza which he experienced. Gave him strychnin and tonics. The improvement in his condition was marked, so much so that in a few days he was up and downstairs. I did not see him again until May 30, 1901. His physician then stated to me that the patient, while being carried upstairs on his son's back the night before, cried out that something had given way in his left side and that he was very faint. He was immediately put to bed and stimulants administered, to which he at once responded. I saw him the next morning and found his pulse 64, and temperature normal.

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He was very nervous, had a sallow cachectic look, and had lost a great deal of flesh. He complained of constipation, and of severe pain in left hypochondrium. Some edema of legs and ankles was present. His heart was much stronger. Hard tumor in left side extending above lower border of ribs, tender, no fluctuation, urine negative. I considered the tumor malignant, which diagnosis was coincided in by several physicians. Advised exploratory laparotomy.

Operation.—June 8, 1901. On examination under ether I found a hard, non-fluctuating tumor extending from above the lower border of the ribs downward to the crest of the ilium and inward to the linea alba, smooth, most prominent just below ribs. Incision made over most prominent part of the tumor. Found an enlarged spleen very dark in color, which was bound down by numerous adhesions. The anterior surface was comparatively free. Anterior wall of abscess thick, posterior wall very thin, indicating that it would have soon ruptured, allowing contents to escape into abdominal cavity. Because of the thinness of the wall and the numerous adhesions I considered an attempt at removal dangerous. Walled off with gauze and made an incision into the spleen through which was evacuated two quarts of creamy pus mixed with a little blood and cheesy-looking material. Cavity curetted, washed out and spleen sutured to abdominal wall with chromicized catgut, iodoform gauze drain. Convalescence rapid and uneventful and in five weeks he was up and dressed. On Aug. 2, 1901, he suddenly became unable to swallow. Aphasia and hemiplegia of the right side appeared, and after this he rapidly failed and died Aug. 4. 1901. Unfortunately an autopsy was not obtained.

Report of Dr. C. D. Smith, who made an examination of the pus: "I fail to find tubercle bacilli, yet the presence of calcareous material is strong evidence of that nature of the abscess. It contains a multitude of lymphoid cells, much pus, a few crystals of hematoidin showing that there has been a hemorrhagic area in the organ or an embolus, and a few bits of characteristic yellow elastic tissue and fragments of spleen tissue."

Several cases of abscess of the spleen have been reported in which the pus was sterile, and from the absence of any previous septic condition, and the constant normal temperature, I am inclined to think that it was sterile in this case.

I ought to have made a correct diagnosis, but was led astray by the absence of fever, the slight pain, the rapid emaciation and extreme constipation. A blood count

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would have been of great assistance. Bessel-Hagen thinks the considerable increase of leucocytes in the blood of the greatest diagnostic significance.

The condition in this case was probably due to an embolus lodging in the splenic vessels which, on account of the slowness of the blood-current in terminal arteries, are peculiarly susceptible to the lodgment of emboli.

SUMMARY OF THE LITERATURE.

In looking over the literature on this subject, I have collected 65 cases, 23 of which occurred after an attack of malaria or typhoid fever, 1 after yellow fever and 3 after appendectomy. The others were ascribed to various causes, such as trauma, disease of heart, sudden chilling of the body after excessive heat, tuberculosis, anthrax, alcoholism and exhaustion. Eight cases in which the etiology was doubtful were probably due to malaria, and in eleven the etiology was unknown. Metastatic abscesses have been reported following osteomyelitis, gunshot wound of the knee and amputations.

Grand-Moursel reports 57 cases, 20 of which were due to malaria; 9 of them diagnosticated, with 8 recoveries, while 11 were recognized only at autopsy. From this it would seem that more cases occur than we are led to believe, which are not diagnosed either before or after death.

ETIOLOGY AND DIAGNOSIS.

The hyperemia of the spleen during malaria and typhoid renders it particularly susceptible to inflammation and abscess formation. All writers agree that the diagnosis is extremely difficult. The chief diagnostic symptoms are history of infectious disease, pain in left hypochondrium which may radiate to left shoulder, night sweats, anemia, loss of appetite and usually chills. Fever may or may not be present; if present, it is of little significance, as it may be due to the original disease. Occasionally extreme constipation is present, but more often diarrhea. Blood count shows increase of leucocytes

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(Bessel-Hagen). Tenderness on deep pressure usually present in the beginning of the attack. Fluctuation is of value as a diagnostic sign only in those cases which are palpable under the abdominal wall.

In such diseases as malaria and typhoid, in which there is commonly an increase in the size of the spleen, the increase alone is not symptomatic of abscess formation, but if the increase in dulness is progressive, and, added to this there are one or two or all of the above-named symptoms, it is at least very suggestive of abscess of the spleen.

If an embolus lodges in the spleen, it may be some time before any enlargement is apparent, and, in fact, I think that a small abscess may form in this way, become encapsulated, remain latent for a long time, and then either be absorbed or receive a severe blow or strain, which may cause a rupture of the capsule, after which a rapid increase in size of the spleen becomes apparent, or several abscesses may coalesce, forming one large abscess. I believe that this occurred in the case described above, and that the abscess ruptured into the substance of the spleen at the time he cried out, while his son was carrying him upstairs. From this time on the increase in size was remarkably rapid.

PROGNOSIS.

If recognized and operated on sufficiently early, the prognosis is fairly favorable. If not operated on, the abscess may rupture into a hollow viscus and the pus be evacuated by means of that organ. More often it will rupture into the peritoneal cavity and death ensue. Three cases among the sixty-five reported above recovered after rupture of the abscess, one opened into the cecum, one into the left lung, and one into the left lung and stomach.

Death of the patient can be attributed more often to the debility following such diseases as malaria, typhoid and tuberculosis than to the operation or the abscess itself.

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TREATMENT.

This is purely a surgical disease. In a few cases splenectomy has been performed, but in order to do this operation successfully the diagnosis must be made very early in the course of the disease, before adhesions have formed. Bessel-Hagen states that splenectomy for splenic, perisplenic and parasplenic abscess was performed seven times, three up to 1890, four in 1891. The same author reports two cases of splenotomy in which the abscess was reached by resection of a portion of the ninth and tenth ribs. Lauenstein also reports one similar case. In the greater number of cases aspiration was first employed, then later incision through the abdominal wall. Splenectomy is the operation to be preferred, but it is limited to those cases in which adhesions have not formed, and to those in which there is no danger of infecting the peritoneal cavity. By this operation we remove the entire organ and its contents at once, thus giving a clean wound, and a much more rapid and satisfactory convalescence. Until we are able to make an early diagnosis, splenotomy is the operation of necessity, and it should be chosen in those cases in which there is great debility and in those in which the abscess wall is thin.

I do not believe that aspiration is necessary in the majority of cases, and its use should be condemned. We should be able to make the diagnosis without its aid, and it subjects the patient to one more chance of infection.

In the early stages of the disease, when the abscess cavity is small and the spleen has enlarged but little, if at all, it is very doubtful if the aspirating needle would throw any light on the diagnosis. Later, when the spleen has increased in size, and possibly fluctuation is present, its use is unnecessary and dangerous. If, after the exposure of the tumor, it is found to be very large, it is wise to aspirate before making a free incision into the spleen, thus diminishing the danger of infection.

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CONCLUSIONS.

1. Abscess of the spleen is rare, but not as rare as we are led to believe.

2. It is most likely to occur after malarial or typhoid fever, because of the hyperemic condition of the spleen in these diseases.

3. Absence of fever does not preclude the possibility of an abscess.

4. Early diagnosis and operation are very essential, and give a fairly favorable prognosis.

5. Splenectomy is the operation of choice, but its application is limited.

6. Preliminary aspiration is an unnecessary procedure, and its use should be condemned.

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GENERAL SURGICAL ANESTHESIA.

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Anesthetics are local, regional and general. General anesthetics are administered by inhalation, and affect the whole system. By their influence on the nervous system they abolish sensation, produce complete muscular relaxation and cause suspension of the power of motion and of consciousness, together with all manifestations of life, excepting the respiration and circulation.

In the light of our present knowledge of practical anesthesia, it is not justifiable to employ any one anesthetic exclusively. The safest anesthesia depends on (1) the choice of the anesthetic best adapted to the individual case; (2) the technic of preparation for and administration of the anesthetic, and (3) a skilful anesthetizer. In a considerable proportion of operative cases the life of the patient depends on the proper choice of the anesthetic and the management of the anesthesia. The recent advances in our knowledge of local and neuroregional anesthesia have materially narrowed the field of general anesthesia.

Almost every kind of operation has been attempted, and more or less successfully performed, under local or neuroregional anesthesia. However, the mere fact that an operation can be performed under local or regional anesthesia is not sufficient justification to do it. The shock to some individuals from even trivial

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operations under local anesthesia is greater than that produced by a properly selected and administered general anesthetic. This is particularly true in some cases of heart disease, as well as in neurotics. It has been found also that postoperative complications occur fully as often after local as after general anesthesia. That, as a rule, a surgeon can do better work under general than under local anesthesia, there can be no question. Nor can there be much doubt that many of the postoperative complications (septic embolism, etc.) after local anesthesia are due to incomplete operating—unfinished work. In children the local method usually is inapplicable. Lastly, the time of the surgeon and the tax on his vitality deserve some consideration. It is not justifiable for a surgeon to fritter away his time on one or two operations under local anesthesia when he might be doing five or six under general anesthesia, with little or no more danger to the patients.

The general anesthetics which deserve special consideration are: ether, chloroform, nitrous oxid, ethyl chlorid, ethyl bromid and pental.

ETHER.

Ether (U. S. P.), ethylic oxid (C_2H_5) 2O, contains about 96 per cent. of ether, the remainder being alcohol. It boils at about 35 to 36 C. (95 to 97 F.), and its specific gravity should not be above 0.720 at 15 C. (59 F.).

Tests.—Ether is neutral to blue litmus. There should be no residue after evaporation of at least 5 c.c. in a glass. Evaporated on C.P. filter paper, it should leave no foreign odor. Held in the hand in a test tube for a few moments, it should boil on the addition of pieces of broken glass. When 10 c.c. is agitated with 10 c.c. of glycerin in a graduated test tube, the ether layer, when fully separated, should not measure less than 8 c.c.

Physiologic Action.—Ether is primarily a diffusible stimulant, like alcohol in its effects. These effects are

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more quickly produced and more transitory than those of alcohol. It increases arterial tension and acts as a cardiac stimulant, the heart continuing to beat after failure of respiration, as a rule. On the nervous system it acts as a paralyzant, affecting, first, the cerebrum; next the cerebellum; then the sensory, and later the motor functions of the spinal cord; then the sensory centers in the medulla oblongata; and, finally, the motor centers in the medulla.

Ether is eliminated chiefly by the lungs and kidneys unchanged, and, to some extent, by the liver and skin.

Postanesthetic Effects.—By this term is meant the conditions which become manifest from the time of awakening from the anesthesia until recovery or death.

Blood.—The hemoglobin percentage is practically always lowered by ether, which means that the oxygen-carrying capacity of the erythrocytes is reduced. John Chalmers Da Costa and Frederick J. Kalteyer[1] studied the blood changes induced by the administration of ether in fifty cases. The average count of erythrocytes before operation was 143,360 less per cubic millimeter than after operation. This was undoubtedly due mostly to the blood concentration caused by preparatory treatment (hot bath, active purgation, withholding all food and liquid for some hours preceding operation) and to sweating during anesthesia. The hemoglobin percentage was apparently increased in nineteen cases—the average gain being 8.05 per cent.—and decreased in twenty-eight cases—an average of 7.25 per cent. The average hemoglobin percentage in all the cases preceding anesthesia was 89; the average percentage following anesthesia was 86, showing an average loss of 3 per cent. The color index was reduced an average of over 8 per cent. The average gain in the number of leucocytes per cubic millimeter after anesthesia was 4,586. It is altogether probable that the

1. Annals of Surgery, September, 1901, vol. xxxiv, p. 329.

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apparent gain in hemoglobin in nineteen of the cases was due to the blood concentration, and that the whole amount of hemoglobin was reduced in every case.

Da Costa and Kalteyer experimented on two rabbits of the same age and size, to determine, if possible, the effect of ether on hemogenesis. One animal was etherized for two hours and twenty minutes. Ten minutes prior to beginning the etherization a blood-count showed 6,140,000 erythrocytes per cubic millimeter, 79 per cent. of hemoglobin, and a color index of 0.693. A second count, 39 minutes after the beginning of the inhalation, showed 6,260,000 erythrocytes, and a color index of 0.592. A third count, 1 hour and 50 minutes after beginning the etherization, gave 7,000,000 erythrocytes, 69 per cent. of hemoglobin, and a color index of 0.485. The animal was then killed with ether.

The other animal was killed by fracturing the spine. On autopsy it was found that the serous cavities of the etherized animal contained no free fluid, while in the other animal the serous cavities contained a small amount of fluid. In the case of the etherized animal the femur marrow was bright red, while that of the other was less red. On microscopic examination, by contrasting the marrow of the etherized animal with that of the non-etherized, it was found that in the former instance there was a marked cell proliferation, the cells being very numerous, and encroaching on the normal fat spaces of the marrow. The cell proliferation in the marrow of the etherized animal involved particularly the erythroblastic elements; these cells were very numerous. These results suggest that the blood-forming organs are busy during ether narcosis manufacturing new blood cells to replace cells that are destroyed by the ether. The new cells are deficient in hemoglobin.

Da Costa and Kalteyer suggest that, in the light of this experiment, it may be that the pains in the limbs and back, so common after anesthetization, may be

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due, at least in part, to changes in the marrow. Recent clinical experience is in accord with these findings.

Kidneys.—There is a difference of opinion as to the effect of ether on the kidneys, but the consensus is that, while it causes more or less irritation during the administration, this effect is of short duration in the kidney not seriously diseased. Some 5 or 6 years ago W. H. Thompson and R. C. Kemp of New York conducted a series of experiments on animals to determine the effect of ether on the kidneys, publishing their results in the *Medical Record.* They found that ether produced contraction of the renal arterioles, with consequent shrinkage of the kidney in bulk, accompanied by diminished secretion, marked albuminuria, and finally suppression. Kemp[2] reaffirms his findings and deductions (1899), and Thompson,[3] in the same year, says that Kemp's experiments show that ether can cause in healthy kidneys acute suppression as complete as that of scarlatinal nephritis. He maintains it is unjustifiable to give ether to one whose kidneys are not healthy, as such an individual is likely to die on the table. Further, he thinks pulmonary edema and aspiration pneumonia likely to occur in these persons. It is quite likely that these animals were given a very much greater relative amount of ether than would be given to a human being by a skilful anesthetizer, consequently the reported results are probably misleading.

By the administration of methylene-blue, it has been demonstrated that ether diminishes the permeability of the kidneys, and it is quite probable that toxic substances are eliminated less rapidly after ether narcosis than occurs with kidneys unaffected by ether.

Clinical experience along this line is conflicting. In a former article[4] I noted that albumin was found in 6 per cent. of 1,500 cases after ether narcosis, where none

2. New York Med. Jour., Nov. 18, 1899.
3. New York Med. Jour., Dec. 2, 1899.
4. Medicine, November and December, 1899.

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had been present before. Casts, hyaline, granular and epithelial, were found in a large proportion of the cases, unaccompanied by albumin. The casts and albumin disappeared rapidly. Wunderlich found that albuminuria and casts may be caused by ether, and that both when present before are increased by ether. According to Carl Beck of New York, out of 300 non-albuminuric ether cases 9 per cent. subsequently had distinct albuminuria. Trieber and Roux examined several hundred cases and failed to find albuminuria in any. Körte found albuminuria in 1 per cent. of 600 cases, and Butler once in 500 cases. Robert F. Weir[5] believes that ether has no marked effect upon healthy kidneys, that it is safe in slight kidney disease, and that circulatory disturbance which may arise in the kidneys quickly subsides. Leppman,[6] after an experimental research, confirms the conclusions of Lengemann and others that ether has no special degenerative action on the healthy kidneys. At any rate, such changes occur very seldom and only to a slight degree. The same may be said regarding the liver. I have records of 100 cases where the urine was tested before and after etherization. In one of these a trace of albumin was found after anesthesia where there was none before. In no case out of several hundred ether anesthesias was there any noticeable post-anesthetic renal trouble. In my judgment, practically all of the especially unpleasant effects of ether on the kidneys have been due to careless selection of cases or bad technic. Cases of anuria have followed ether narcosis in persons suffering from chronic nephritis. In such cases general anesthesia is contraindicated. In advanced nephritis local anesthesia should be employed in preference to general, but if a general anesthetic must be given, nitrous oxid or ether are probably the

5. New York Med. Jour., Nov. 16, 1895.

6. Mittheilungen aus den Grenzgebieten der Med. und Chirurgie, 1899, Bd. iv, Heft. 1 (quoted by Joseph C. Bloodgood, Prog. Medicine, December, 1901).

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safest of any. Much depends on the management of the case before, during and after the anesthesia.

Respiratory Tract.—Ether is distinctly irritating to the membrane of this tract and markedly increases the secretion of mucus, the degree of irritation depending much on the technic of administration. Lung complications may be due to: 1. The direct irritating action of the anesthetic on the mucous membrane. 2. The toxic effect of the anesthetic on the cardiovascular system, producing dilation of the vessels and of the heart, and hyperemia and edema of the lungs. This condition favors hypostatic pneumonia and reduces the resistance of the lung to infection, which may be caused by inspiration, by septic or non-septic emboli, or by bacteriemia. 3. Chilling, fright and shock reduce the physiologic resistance and act as indirect factors in the production of pneumonia. General weakness of the patient from any cause acts in a similar manner. 4. The restriction of respiration and of expectoration by the pain of an abdominal wound or by tight bandaging of the chest or abdomen. 5. Keeping the patient in the dorsal decubitus too long. 6. The so-called aspiration or deglutition pneumonia—most liable to occur after operations about the mouth and throat, in which loss of control of some of the muscles of deglutition is more or less complete.

Lung edema is present during the administration of ether and for several hours after, and it increases the possibility of hypostatic and aspiration pneumonias. The danger of aspiration pneumonia is greater where there are suppurative lesions in the mouth and pharynx.

Embolic pneumonia occurs independently of the anesthesia. The embolus may be septic, as from thrombosed veins contiguous to infections of the pelvis or of the lower extremities, or they may be non-septic and produce infarcts which become infected.

The lowering of the temperature during anesthesia undoubtedly contributes to the production of bronchitis,

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pneumonia, etc. By no means can all of the lung complications which follow the administration of a general anesthetic be attributed solely to the effect of the anesthetic. Many of them are probably due to infection from without or to autoinfection; they occur after local anesthesia as well as after general. Gottstein[7] was one of the first (1898) to report lung complications after celiotomy under local anesthesia. From the Breslau clinic of Mikulicz he reported 27 cases of lung complications following 114 celiotomies, about 15 per cent.; while in 119 celiotomies in the same clinic under general anesthesia there were but 7 cases. However, the majority of the graver cases were operated on under local anesthesia.

Mikulicz (German Surgical Congress, 1901) reported that in 1,007 celiotomies and operations for goiter under general anesthesia there were 7.5 per cent. of pneumonias, with 3.4 per cent. mortality; while in 273 celiotomies under local anesthesia there were 12.8 per cent. of pneumonias, with a mortality of 4.8 per cent.

Mr. Sidney Rumboll[8] of London reports 1,500 oxygen-ether narcoses, with only one case of bronchitis, one of pneumonia, and four of trifling bronchial irritation. In 1,250 ether administrations in the Royal Free Hospital, London, there were 3 instances of pulmonary trouble. In one, the preëxisting signs of phthisis were increased; in a hernia case and one of injury to the chest pneumonia developed. In some 300 of my own ether cases, of which records were kept, I find but one case of lung complication. This was a moderate aggravation of an acute bronchitis which had not quite subsided at the time of the anesthesia. I recall no case of serious lung complication resulting from ether in any of my cases.

The cases of lung complication following local an-

7. Archiv f. Klin. Chir., Bd. lvii, Heft 2 and 3.
8. American Year Book of Med. and Surg., 1901.

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esthesia demonstrate that the nature and extent of the operation, especially celiotomies and operations on the mouth, neck and thoracic cavity, contribute to the production of these complications.

Cardiovascular System.—Ether causes a temporary rise in the carotid blood-pressure, followed by a moderate and gradual fall. The capillaries are dilated; the vascular tension increased. It produces no marked degenerative changes in the heart.

CHLOROFORM.

Trichloromethane or methenyl chlorid ($CHCL^3$) is a limpid, colorless liquid of the sp. gr. 1,502 at 15 C. It boils at 60-61 C. (140-142. 8 F.), and is very slightly inflammable. It is decomposed by daylight into hydrochloric acid, chlorin and free formic acid. This decomposition may be prevented by the addition of 0.5 to 1 per cent. of alcohol—the medicinal chloroform of the U. S. Pharmacopeia and the British Pharmacopeia contains 0.6 to 1 per cent. of alcohol. Impurities found in chloroform are spirits of wine, ether, etc., methyl compounds (formed during its preparation), and the decomposition products.

Tests.—A ready, practical test for impurities is the smelling test. A piece of C.P. filter paper is moistened with chloroform, when, on evaporation, if the chloroform be pure, no odor will be left in the paper. If 5 c.c. be shaken with 10 c.c. of distilled water, the latter, when separated, should not affect blue litmus (absence of acid), nor test solution of silver nitrate—1/20—(chlorids), nor test solution of potassium iodid—1/20—(free chlorin). Alcohol may be detected by adding to the warmed liquid a little iodin, a few drops of solution of soda, again warming gently and setting aside for a time; a deposit of iodoform crystals (CHI_3) is obtained (Lieben's test).

Physiologic Action.—When kept in contact with the skin for a time, it causes irritation and, finally, vesication. When inhaled it is irritant to the respiratory

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mucous membrane. Internally it acts as a carminative, anti-spasmodic and sedative. In large doses it is a local irritant. When introduced into the circulation, whether by inhalation or by the stomach, its effects are the same. After a brief period of stimulation it acts as a sedative and, in overdose, is a cardiac poison. It was demonstrated by Prof. John A. MacWilliam of Aberdeen that, even when slowly inhaled in moderate quantities and with a good admixture of air, chloroform causes an appreciable dilation of the heart.

Chloroform is eliminated chiefly in the form of chlorids by the kidneys; about a third is excreted as chloroform by the lungs and kidneys. It may also be found in the milk of nursing women and in the fetal blood. Owing to its destructive action on the erythrocytes it produces hemoglobinuria and bilirubinuria. As demonstrated by K. Buedinger,[9] chloroform elimination continues for several days after administration. He found it in the sputa as much as 5 days after administration. Much mucous secretion means slow elimination, the chloroform evidently combining with the mucus.

Effect on the Nervous System.—The ganglion cells are chiefly affected. However, the first effects are on the terminals of the fifth nerve in the nose, and the vagus (reflex irritation of the latter), thus influencing both circulation and respiration—first stimulation, then depression. There is at first, by its action on the vasomotor center and on the cardiac ganglia, increased arterial pressure, quickly followed by a marked and progressive fall in the pressure, tension and cardiac action. The arteries are contracted. There is primary dilation of the pupils, due to psychic reflex irritations; later, contraction. As in the case of ether, there is first sensory paralysis and then motor, the cerebrum being affected first, then the cord, and last, the motor

9. Wien. Klin. Woch., Aug. 1, 1901 (quoted in THE JOURNAL Am. Med. Assn., vol. xxxvii, p. 608).

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part of the medulla. Loss of sensation is first in the back and extremities and last in the cornea.

POSTANESTHETIC EFFECTS.

Blood.—There is little room for doubt that chloroform combines with the erythrocytes, causing death of a considerable proportion of them, and marked lessening of the hemoglobin — the oxygen-carrying element. In 1890, Mikulicz noted that the administration of chloroform may reduce the hemoglobin from 5 to 10 per cent. In 1893, Garrett and Oliver concluded, as a result of experiments, that anesthetics, particularly chloroform, deoxidize the blood and the tissues, thus producing malnutrition and the formation of quantities of waste products, the elimination of which causes a severe, and possibly a fatal, strain upon the excretory glands.

Kidneys and Liver.—Experiments on healthy animals and autopsies on man prove that chloroform produces fatty degeneration of the kidneys and liver. The experiments of Thompson and Kemp apparently indicate that the immediate effects on healthy kidneys are slight, as albuminuria when present during narcosis was slight, and the secretion of urine continued up to the last moment of life. Fränkel called attention to the fact that chloroform sometimes gives rise to fatty changes in the kidneys and liver from which death may result. Wunderlich found, from investigation in 125 cases, that albumin when present was not increased by chloroform, but that albuminuria and casts were not seldom caused by it; that chloroform nephritis occurs. In 70 cases of chloroform anesthesia reported by Patein, 12 per cent. showed albuminuria before, 15 per cent. during, and 73 per cent. after anesthesia. As a rule the albumin disappeared within 48 hours, and the length of the anesthesia seemed to bear no relation to the albuminuria. D. N. Eisendrath[10] reported that albuminuria was present in 15 per cent. of 650 cases after chloroform an-

10. Chicago Medical Recorder, June, 1897.

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esthesia where there was none before, and in 6 per cent. of 1500 cases after ether where none had been present before. Casts were found unaccompanied by albumin more frequently after ether. In over half of the cases there were casts where no albumin was found. Casts and albumin disappeared rapidly, more so after ether than after chloroform. L. Wechsberg of Vienna[11] tested the urine in 100 cases of chloroform anesthesia, finding biliary pigments in 16, and in most of these there was icterus, probably indicating some abnormal condition of the liver.

Respiratory System.—The first effect produced by chloroform is reflex irritation of the vagus through the terminals of the fifth nerve in the nose. The after-effects on the lungs and bronchi are similar to those of ether, only less pronounced. A large proportion of the chloroform taken into the system is eliminated by the pulmonary mucous membrane, and, being heavy, it is eliminated slowly. Besides its direct irritating effect during inhalation and elimination, it undoubtedly lowers the physiologic resistance and leads indirectly to the occurrence of bronchitis and pneumonia.

Cardiovascular System.—Fränkel[12] proved beyond a doubt that fatty degeneration and fragmentation of the heart muscle, both in man and animals, follow the administration of chloroform as an anesthetic. Previous to Fränkel's publication, several observers had noted similar changes in animals after chloroform inhalation. Since then, Ambrosius, Mathen, Bastianelli, Heinz and others have reported cases of the kind in man. Lengemann,[13] experimenting on dogs with definite amounts of chloroform, found that the amount of chloroform given made very little difference in the extent of the fatty degeneration of the different organs. While a certain amount of chloroform must be in circulation

11. The Journal Am. Med. Assn., vol. xxxviii, p. 1340.
12. Virchow's Archiv, 1892 (quoted by Bloodgood, Progressive Medicine, 1901).
13. Beitrage zur Klin. Chir., 1900, Bd. xxvii, Heft 3, p. 805.

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before fatty degeneration can be produced, he found that this quantity was always present when sufficient chloroform had been given to produce narcosis. Repeated narcoses increased the extent of the degeneration. A large proportion of the cases where fatty degeneration of the heart was found in man occurred after anesthesias, prolonged for 2 or 3 hours, and this accords with *a priori* reasoning.

Chloroform practically always produces a dilation of the heart during administration. This cardiac weakness may in some cases be prolonged, either from myocardial changes produced by the anesthetic or from shock and other disturbances due to the operation and the anesthetic, and lead to pneumonia, embolism, or gastrointestinal troubles. Many of the unfortunate effects of anesthetics result from disturbances of the nervous mechanism rather than to organic changes of the heart.

NITROUS OXID.

Nitrogen monoxid, laughing-gas (N_2O), is a transparent, colorless gas, having a sweetish taste, almost odorless, and of neutral reaction; is taken up by water and by alcohol. It is reduced to a liquid by pressure and stored in metallic cylinders. When wanted for inhalation the container is connected with a receiver, when the liquid, on liberation, immediately becomes a gas. The gas is non-combustible, but ranks next to oxygen as a supporter of combustion.

Physiologic Action.—Formerly it was thought that nitrous oxid was merely an asphyxiant, that its anesthetic properties were due entirely to its exclusion of oxygen. It is, however, a true anesthetic, and may be given with an admixture of air or oxygen with the result of producing quiet anesthesia without asphyxial phenomena.

Nitrous oxid is non-irritant, or nearly so, to the respiratory mucous membrane. It causes a positive and rapid rise in the blood-pressure, while there is slowing

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of cardiac action. Soon the heart beats faster and there is a fall in arterial pressure, due to vasomotor paresis. The respiration is labored and may be arrested by obstructive stertor or spasm of the respiratory muscles. When given without admixture of oxygen it produces asphyxia, manifested by stertorous respiration, cyanosis and dilation of the pupils—and in these cases the anesthetic effects are due largely to the asphyxia. In deep narcosis from nitrous oxid the renal vessels are contracted, the secretion of urine is diminished, and albumin may be found. The gas is eliminated unchanged by the kidneys and lungs.

The after-effects of nitrous oxid are, as a rule, transient; limited to slight dizziness, nausea or headache, lasting a few hours. Occasionally there may be albuminuria or dilation of the heart, the latter continuing for several days.

Nitrous oxid has until recently been employed for short anesthesias only, chiefly for tooth extraction. In 1899 Frederick W. Hewitt[14] published his deductions from observation of 231 cases of nitrous oxid narcosis. Pure nitrous oxid was given in 22 cases; nitrous oxid mixed with different percentages of air, 107 cases; nitrous oxid mixed with different percentages of oxygen, 102 cases. He concludes that when pure nitrous oxid is given the most conspicuous of the anesthetic phenomena are embarrassed and deeply stertorous breathing, cyanosis, and anoxemic convulsion. Other less obvious asphyxial phenomena are dilation of the pupils, swelling of the tongue and adjacent structures, and rapid cardiac action. All these may be eliminated or greatly modified without interfering with the anesthetic effects of the gas by administering it with certain proportions of oxygen, either pure or atmospheric. If the administration be pushed far enough, breathing is arrested by obstructive stertor, by anoxemic convulsion attacking the respira-

14. British Med. Jour., Feb. 18, 1899.

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tory muscles, or by both combined. Paralytic cessation of breathing is very rare, and when it occurs is dependent quite as much on cerebral anemia from defective circulation as on the presence of unoxygenated blood in the vessels supplying the respiratory center. The deep and obstructive stertor of pure nitrous oxid narcosis is not met with when employing mixtures containing moderate percentages of air or oxygen, and when the percentage of oxygen is considerable—30 per cent. air or 13 per cent. oxygen—respiration becomes noiseless and free from obstruction. The most marked cyanosis appears when as little as 3 to 6 per cent. of air or under 3 per cent. of oxygen are admixed. With pure nitrous oxid, cyanosis may not become pronounced, for the administration may be cut short by deep stertor. With 30 per cent. of air cyanosis is very slight, and with 11 per cent. of oxygen it disappears. Anoxemic convulsion, like cyanosis, is liable to be greater with small percentages of air or oxygen than with pure nitrous oxid, but with 30 per cent. of air or 6 per cent. of oxygen it ceases to occur. Reflex and excitement movements are most apt to arise with or without admixture of small percentages of air (3 to 7 per cent.), or with considerable percentages of air (20 to 30 per cent.), or of oxygen (10 to 20 per cent.). They are least apt to occur with mixtures containing moderate quantities of air (12 to 16 per cent.) or of oxygen (3 to 7 per cent.). The duration of available anesthesia after inhalation was found to be longest after administration of mixtures containing from 3 to 11 per cent. of oxygen, the maximum having been obtained with a 7 per cent. mixture. With nitrous oxid and air mixtures the anesthesia was distinctly longer than with pure nitrous oxid, but the results were very uncertain. The shortest available anesthesias were with pure nitrous oxid and with nitrous oxid containing 30 per cent. of air. The investigation shows that the best results were obtained with mixtures of

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nitrous oxid and oxygen; the next best with nitrous oxid and air; and the worst with pure nitrous oxid.

Hewitt says: "There is no one mixture of nitrous oxid with air or oxygen which will successfully anesthetize every patient.

"In order to obtain the best form of anesthesia, oxygen should be administered with nitrous oxid by means of a regulating apparatus, the percentage of the former gas being progressively increased from 2 or 3 per cent. at the commencement of the administration to 7, 8, 9 or 10 per cent., according to the circumstances of the case. The longer the administration lasts the greater may be the percentage of oxygen admitted.

"The next best results to those obtainable by means of a regulating apparatus for nitrous oxid and oxygen are to be secured by administering certain constant mixtures of these two gases. Mixtures containing 5, 6 or 7 per cent. of oxygen are best for adult males; and mixtures containing 7, 8 or 9 per cent. are best for females and children. The next best results to those last mentioned are to be obtained by means of mixtures of nitrous oxid and air, from 14 to 18 per cent. of the latter being advisable in anesthetizing men, and from 18 to 22 per cent. in anesthetizing women and children."

Herbert J. Preston, senior assistant anesthetist, St. Bartholomew's Hospital, London, after administering pure nitrous oxid—allowing occasional breaths of pure air—in nearly 200 cases, the anesthesias lasting from 10 to 50 minutes, and nitrous oxid and oxygen mixed in 150 cases, the anesthesias lasting from 15 to 65 minutes, concludes that the mixture is better for anesthesia than the pure nitrous oxid. He observed no bad effects and very little nausea (sometimes one emesis).

S. Ormond Goldan[15] reports an efficient nitrous oxid anesthesia lasting 160 minutes.

15. Medical Record, March 3, 1900.

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Nitrous oxid is by far the safest general anesthetic we have. According to H. C. Wood[16] there were but 4 recorded deaths up to 1900 which could be certainly attributed to the drug. Hewitt,[17] however, records 17 deaths positively due to nitrous oxid, and 6 others probably due to it. Obviously, it is not entirely without danger. It is probably within the bounds of fact to estimate the death rate as low as from 1 to 3 in 1,000,000 narcoses.

The chief danger in administering nitrous acid is from asphyxia, either directly or indirectly. The indirect asphyxial effects may be manifested by secondary dilation and paralysis of the heart or to apoplexy due to sudden increase in arterial pressure. To avoid the last named difficulty, it has been suggested that in old or arteriosclerotic persons a hypodermic injection of nitroglycerin be given before the anesthesia. It is not necessary to give the nitroglycerin hypodermically, for the reason that if dissolved in the mouth this substance is absorbed so quickly that its full effects on the cardiovascular system are manifested in from 2 to 5 minutes. Nitrous oxid is contraindicated in the presence of valvular degeneration.

The use of nitrous oxid and oxygen is satisfactory only when it is given by one skilled in its administration. Dudley W. Buxton, in his work on anesthetics, says: "Success in the use of this method can be obtained only by the most careful attention to details. . . . Experience alone can enable the administrator to regulate the amount of oxygen required for any given case. . . . Oxygen is an adjunct, and not an adjuvant anesthetic like ether."

ETHYL BROMID.

Hydrobromic ether (C_2H_5Br) is a colorless, very volatile liquid, of neutral reaction, and having the sp. gr. 1,450 at 15 C. (59 F.); is sparingly soluble in

16. H. C. Wood, Text-Book on Therapeutics, 1900.
17. F. W. Hewitt, Anesthetics and Their Administration, 1901.

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water, freely so in alcohol and in ether. Evaporated on a plate, no foreign odor should remain. It has a strong smell and hot taste; is non-inflammable and non-explosive. It was discovered early in the nineteenth century by Sérullas of France. For use as an anesthetic the chemically pure drug must be employed —and it should be remembered that the C.P. article easily undergoes changes, on exposure to air and light, which render it especially dangerous.

Ethylene bromid is similar to but much more dangerous than ethyl bromid.

Ethyl bromid is almost non-irritant to the respiratory mucous membrane—by some it is believed to be sedative to this membrane. H. C. Wood found that its action on the heart was about the same as that of chloroform, and death occurs usually from cardiac paralysis. During its administration the skin and lips should not change color, nor the pupils become dilated.

The after-effects are generally limited to slight vertigo, nausea or headache. There is a garlicky odor to the breath for from one to three days after administration.

It is not at all safe to give ethyl bromid for more than 2 or 3 minutes, as longer administration is very liable to cause circulatory and respiratory failure. It is administered in 4 to 12 gram doses without admixture of air.

ETHYL CHLORID.

Hydrochloric ether, kelene, ethyl monochlorid (C_2H_5Cl), is a thin, colorless, inflammable and very volatile liquid, of an agreeable, sweetish taste and pleasant odor. Its sp. gr. at 0 C. is 0.9214, and its boiling point 15 C. It dissolves in water to the extent of 1 part in 50 by weight, and readily dissolves fixed and volatile oils. It is highly inflammable and its combustion produces strong chlorin fumes.

Ethyl chlorid was discovered by Rouelle, but Basse

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was the first to obtain it in sufficient quantity for complete examination. H. C. Wood and David Cerna have found that in the blood it acts much like chloroform. According to Martin W. Ware,[18] the breathing during ethyl chlorid narcosis is somewhat stertorous, the pulse accelerated with no appreciable fall of pressure. There is flushing of the face, followed by free perspiration, slight jactitation, followed by a spastic state of the muscles which subsides as the narcosis deepens. The chest muscles are not thus affected. Narcosis is reached when the pupils begin to contract, the muscular contractions to abate and breathing becomes slightly stertorous. There is some variation in these phenomena in the case of alcoholics, neurotics and children. Ordinarily, it is administered by spraying on gauze in a funnel which has an air valve and fits the face. For short anesthesias all air is excluded. James P. Tuttle of New York believes it is best given on the ordinary chloroform inhaler.

Lotheisen[19] reported a death from ethyl chlorid in the case of a man aged 41 on whom the surgeon was performing skin-grafting. After 3 minutes of narcosis the patient became cyanosed and the muscles of the extremities and jaws became spasmodically tense. Breathing became irregular and suddenly ceased. Artificial respiration availed nothing. Autopsy showed fatty degeneration of the heart and sclerosis of the coronary arteries.

Weisner[20] believes ethyl chlorid is particularly useful in fatty degeneration of the heart and allied affections and in respiratory disorders; also if operation is necessary after hemorrhage or in shock. He says that there is no excitement except in alcoholics; that respiration and circulation are not disturbed and the tongue does not fall back; that return of consciousness is prompt

18. Medical Record, vol. lix, No. 14.
19. Munch. Med. Woch., No. 18, 1900.
20. Wien. Med. Woch., July 8, 1899.

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and vomiting rare. In complete narcosis the patient may be able to answer questions, but will not remember. The eye reflexes are not always abolished; there is not complete muscular relaxation; and the patient may regain consciousness during the operation. It has, however, been employed in operations requiring about an hour.

My experience with ethyl chlorid as a general anesthetic is *nil,* but from the data at hand I am inclined to class it with the more dangerous anesthetics, and would expect it to be especially dangerous in cardiac and respiratory troubles. Benjamin W. Richardson has asserted that an anesthetic is dangerous in proportion to the chlorin it contains, and it may be that his belief was founded on sound principles. Almost every reporter on ethyl chlorid anesthesia mentions a death in the literature. Although several deaths have probably occurred, it is likely that repetitions have occurred in the reports. Lotheisen (1900) reports 1 death in 2,500 cases, while Ware (1902) says that but one death has been reported in over 13,000 cases. He places its safety between that of ether and that of nitrous oxid.[21]

PENTAL.

Trimethylethylene, B-isoamylene $(CH_3)_2C$, is a colorless, very volatile and inflammable liquid, of a strong odor. It boils at 38 C. (100.4 F.), is insoluble in water, mixes in all proportions with alcohol, chloroform and ether, and does not decompose on exposure to air and light.

It is said to be unirritant to the respiratory mucous membrane. H. C. Wood and David Cerna show that it is a cardiac depressant. Albuminuria, and sometimes hematuria and hemoglobinuria, occur 3 or 4 days after its administration (N. Kleindicust). Gurlt's statistics give 6 deaths in 600 anesthesias.

Administered by inhalation, 8 to 12 grams are usually sufficient to produce anesthesia. Loss of sensibility oc-

21. American Medicine, vol. iii, p. 1043.

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curs within 50 to 90 seconds without entire abolition of consciousness, but the effect may be pushed to profound anesthesia. The pupils sometimes dilate widely. Return to consciousness is gradual. Pental has been used little or not at all in the United States, but in Europe it was tried quite extensively some years ago. It has been almost discarded as a practical anesthetic.

EFFECTS OF ANESTHETICS DURING NARCOSIS.

As to ether there is little difference of opinion, nearly all agreeing that in almost all cases its dangerous effects are manifested primarily by disturbances of the respiratory system.

In the case of chloroform the diversity of opinion is great. N. Senn agrees with the second Hyderabad Commission (superintended by Lauder Brunton), that chloroform kills by its effect on the respiratory system. My belief has always been that the bad effects of chloroform were, as a rule, exerted primarily on the circulatory system, and increasing experience and observation go to confirm that belief. The circulatory and respiratory systems are very greatly interdependent, consequently that which affects one will also affect the other. This fact partly accounts for many erroneous interpretations of anesthetic narcosis phenomena. The majority of reports of deaths from anesthetics show evidences of inaccurate observations. Many times this is excusable, because when accidents occur the prime consideration is for the life of the patient and no time can be spared for technical observations. However, the majority of accidents might be avoided by closer attention to details and early recognition of conditions present.

Chloroform Syncope.—Leonard Hill[22] shows that there are two forms of chloroform syncope—primary and secondary—both forms being due to circulatory depression. Practically all observers agree that chloroform causes lowering of blood-pressure at all stages of the anesthesia,

22. Brit. Med. Jour., April 17, 1897.

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excepting momentarily at the beginning. The tracings of the Hyderabad Commission show that blood-pressure falls greatly before respiration ceases, but the Commission claims this has nothing to do with the heart, and that failure of respiration is the primary cause of death. If this be true, artificial respiration should be successful always, for it is well known that if the respiratory center be excised an animal can be kept alive for hours by means of artificial respiration. Lessening of blood-pressure is attributable partly to vasomotor paralysis and partly to cardiac failure. In rapid administration of an anesthetic the circulatory organs are in danger, and in slow administration the respiratory. Ether produces a slow fall of the blood-pressure, and chloroform a rapid.

Hill says: 1. Chloroform causes primary failure of circulation and secondary failure of respiration. The respiratory center fails to act, partly because of anemia produced by the great fall in arterial tension. This statement is proved by the fact that activity of the respiratory center can be restored by raising the arterial tension. The depth of anesthesia and the paralysis of the respiratory center depend upon the primary fall of arterial tension.

2. Chloroform more than any other agent known rapidly abolishes the mechanisms of the vascular system which compensate for the hydrostatic effects of gravity.

3. Chloroform abolishes these mechanisms by paralyzing the splanchnic vasomotor tone, and by diminishing the power of the respiratory pump. When these mechanisms are entirely destroyed circulation is impossible if the patient is in the feet-down position.

4. Chloroform produces paralytic dilation of the heart, acting like amyl nitrite on the musculature of the entire vascular system.

5. There are two forms of chloroform syncope—that occurring during primary anesthesia, and that occurring during prolonged anesthesia. In the syncope which occurs during primary anesthesia the patient struggles,

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holds his breath, raises the pressure within the chest, congests the venous system greatly, lowers arterial tension, and finally makes several deep inspirations, thus charging the lungs with chloroform vapor. In the first stage the left heart becomes impoverished, and in the second stage it suddenly fills with blood. This blood is drawn from the lungs and is saturated with chloroform. Respiration and pulse cease simultaneously, or the pulse ceases before respiration. The syncope which occurs during prolonged anesthesia arises from gradually giving chloroform beyond the safe limit. The arterial pressure diminishes more and more and the respiration ceases secondarily, because of anemia of the respiratory center. The heart is not paralyzed by chloroform in these cases, because it is taken in gradually by the shallow respiration and is distributed slowly by the feeble circulation.

6. A patient can be resuscitated by artificial respiration and the horizontal posture.

7. Artificial respiration carried out with the patient in a horizontal position is the treatment indicated primarily in the first form of syncope. The heart may be rhythmically compressed by squeezing the chest. If these measures do not quickly cause the pulse to appear, the patient should be placed in a vertical position with the feet down. The dilated right heart is thus completely emptied, artificial respiration is continued during this change of posture, and the patient is brought again into the horizontal position. By rhythmic compression of the chest circulation is maintained through the coronary arteries. If this maneuver fails in the first trial it is repeated.

8. Placing the patient in the feet-up position or compressing the abdomen will simply increase paralytic dilation of the heart. In other words, in syncope occurring during primary anesthesia both of these methods of treatment do harm rather than good.

9. Shock or fear act like chloroform in tending to

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abolish the compensatory mechanisms for the hydrostatic effects of gravity, and giving the patient chloroform may be the last straw which completely paralyzes the circulation.

10. Pneumogastric inhibition of the heart is of no importance as an agent in the causation of chloroform syncope.

11. Ether is a vastly safer agent for anesthesia than chloroform (according to Ringer fifty times less dangerous).

I believe that those who hold that chloroform affects primarily and chiefly the respiratory system either overlook the rationale described above, or do not fully comprehend it. If there are exceptions to the rule they are not numerous. The Anesthetic Committee of the British Medical Association say, in their recently issued report: "When danger occurs under chloroform, whatever its exact nature may be, there is abundant evidence that in a large proportion of cases the symptoms that are observed are those of primary circulatory failure."

E. H. Embley[23] of Australia has conducted a series of 120 experiments on dogs to ascertain the part played by vagus inhibition in chloroform poisoning. In 54 cases vagus inhibition embarrassed the circulation to a more or less dangerous extent, and in 33 experiments was the immediate cause of death. Two per cent. or upwards of chloroform vapor in the air inhaled is liable to bring on dangerous vagus inhibition. Embley finds that failure of respiration during chloroform administration is mainly due to fall in blood-pressure, and that restoration of failed respiration is dependent on restoration of blood-pressure.

Careful analysis of my clinical experience and of all the data at my disposal confirms me in the opinion that Hill's deductions are correct, excepting as to vagus inhibition. It would seem that Embley's conclusions on

23. E. H. Embley, "The Causation of Death During the Administration of Chloroform," Brit. Med. Jour., April 5, 12 and 19, 1902.

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that point are well founded and practically beyond argument.

The practical lesson taught by Hill's and Embley's investigations is, to administer only weak vapor of chloroform at any stage of anesthesia, but especially in the early stage before the initial increased excitability of the vagus mechanism has given place to diminished excitability.

MIXTURES AND SEQUENCES OF ANESTHETICS.

Both of these have their advocates, and with good reason in selected cases, especially as regards the sequences. These seem to be gaining prestige, especially the preliminary administration of one of the quick-acting and less disagreeable anesthetics—nitrous oxid—and continuing the narcosis with ether. A large number of combinations of ether and chloroform; ether, chloroform and alcohol; ether and alcohol; chloroform and alcohol, etc., have been used and warmly advocated. Morphin given before or during anesthetic inhalation produces mixed anesthesia; as do chloral, chloretone, cocain and other drugs. The weight of opinion is against the use of mixed anesthetics for routine work.

Ether and Chloroform Mixtures.—The "A.C.E. mixture" (1 part alcohol, 2 of chloroform, and 3 of ether, by measure), the "Billroth mixture" (alcohol 1 part, ether 1, and chloroform 3) and the "Vienna mixture" (chloroform 1 to ether 6) have been employed more extensively than any of the others. Lawson Tait's mixture (chloroform 1 to ether 2) is in high favor with some of the Scotch surgeons. Of 14,181 anesthesias with this mixture there were 3 deaths, and only one of them could properly be laid to the anesthetic.[24] It is admitted that at times during this series of anesthesias there was great anxiety for patients, when artificial respiration and other means of resuscitation had to be resorted to and another anesthetic substituted. William E. Burton

24. W. J. McCardle, Birmingham, Lancet, London, 1898, vol. ii, p. 1621.

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of Dublin advocates a mixture of 1 part of ether to 17 of chloroform. Sir Spencer Wells tried a mixture of chloroform and alcohol. All such mixtures are used with the view of reducing the danger from chloroform.

Ether-Oxygen Mixture.—A mixture of ether and oxygen is used by a number of surgeons. Dr. T. S. K. Morton[25] began using this mixture in 1895. He credits H. B. Northup of Philadelphia with first suggesting the simultaneous use of oxygen with an anesthetic. Primary anesthesia is obtained with ether before the oxygen is turned on. This does away with the objection made by Keen, DaCosta, McCosh and others that anesthesia is delayed when oxygen-ether is used. After anesthesia has been induced by the usual methods, it can generally be maintained with the oxygen-ether mixture. The color of the patient's face is usually of a healthy pink hue throughout the anesthesia, the heart beats full and strong with no undue acceleration. The respiration is generally full, deep, and not much increased in frequency. Much less mucus is secreted, and, therefore, choking is infrequent. The mixture is more explosive than ether, hence especial caution is necessary with lights and the cautery. This method is, of course, unsuited to any but hospital practice.

Schleich's Mixtures.—Dr. Carl Ludwig Schleich of Berlin[26] recommends for general anesthesia a mixture consisting of:

℞. Ethyl chlorid .....½ part to 2 parts.
Chloroform .....4 parts.
Anesthetic ether ..... 12 parts.

He records that he has used this mixture in about 5,000 cases without any bad results.[27] Some years ago Schleich gave it as his belief that mixtures of anesthetics of different boiling points are safer than the different anesthetics alone, on the assumption that the absorption of an anesthetic as to quantity depends on its boiling

25. Annals of Surgery, vol. xxviii, p. 272.
26. Berliner Klinische Wochenschrift, vol. xxxviii, p. 269.
27. E. H. Squibb's Ephemeris of Materia Med., January, 1901.

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point. The more volatile an anesthetic the slower will be its rate of absorption. Ether, which boils at about 36 C. (97 F.) will be absorbed less rapidly than chloroform, the boiling point of which is about 61 C. (142 F.). He believed that if an anesthetic could be produced with a boiling point the same as the normal temperature of the blood, the exact amount absorbed with each inspiration would be eliminated with each expiration. He thinks that by producing mixtures with maximum evaporation points at different degrees above the blood temperature, we can regulate at will the excess which the expiration would not remove, and thus the amount of anesthetic retained in the blood. In order to accomplish this he added petroleum ether or benzine (boiling point 60 to 65 C.) to ether and chloroform in different proportions. His mixtures for inhalation consisted of three solutions:

No. 1, Boiling Point 38 C. (for Brief Anesthesia).

℞.	Ether	℥vi	186	
	Petroleum ether	℥ss	15	5
	Chloroform	℥iss	46	5

No. 2, Boiling Point 40 C. (for Medium Anesthesia).

℞.	Ether	℥v	155	
	Chloroform	℥iss	46	5
	Petroleum ether	℥ss	15	5

No. 3, Boiling Point 42 C. (for Prolonged Anesthesia.)

℞.	Ether	℥2 2/3	83	
	Petroleum ether	℥ss	15	5
	Chloroform	℥i	31	

Schleich claimed for these solutions that the anesthetist might be guided, as to the effects of the anesthetic, by the respiration alone; that there was no excitement, no tendency to irritate the bronchial tubes; the pulse had good tension and was never increased, but might be decreased, in frequency; that consciousness was regained more quickly than from ether or chloroform narcosis; and if the solution with a boiling point at about blood temperature were used, only a few respirations were taken before the patient became conscious.

These solutions were received with considerable en-

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thusiasm by a number of American surgeons, among them Henry J. Garrigues, H. Rodman, and Walter Lathrop, the latter using them in 700 cases. Schleich's claims were not sustained in any very important respect, and so far as I know the solutions are not used here. My own experience with them was limited to 15 consecutive anesthesias, in 1898, when I encountered a case which convinced me that the solutions were at least as dangerous as chloroform. I believe the ethyl chlorid mixture will not stand the test of time better than his old mixtures.

Schleich's reasoning, that if an anesthetic could be produced with a boiling point the same as the normal temperature of the blood, the exact amount absorbed with each inspiration would be eliminated with each expiration, is fallacious, because a certain amount of the anesthetic would be retained in the blood and eliminated in part through the kidneys; and, moreover, the temperature of the body tends always to become reduced during anesthesia. In other words, the temperature of the body is not a constant quantity during anesthesia.

I do not believe that any form of chloroform mixture can be made as safe for routine use as ether.

Willy Meyer[28] reports his experience with "anesthol," a new anesthetic which he and H. P. Weidig, Ph.D., of Newark, N. J., have evolved out of the Schleich mixtures. Dr. Weidig found that if chloroform and ether are mixed together in the right proportions, based on their molecular weights, they entered into chemical solution, producing a new anesthetic. That is, ether and chloroform dissolved in each other in molecular proportion will resist fractioning by distillation. In other words, the solution has an evaporating point of its own. Seventy-four grams of absolute ether (molecular weight 74) and 119.5 grams of C.P. chloroform (molecular weight 119.5) mixed together enter into this so-called chemical combination. It contains neither free ether nor free

28. The Journal Am. Med. Assn., Feb. 28, 1903, vol. xl, p. 553.

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chloroform, and has a boiling point of 52 C. (125.6 F.). They call this product molecular solution (of ether and chloroform). Expressed in volume, it represents 56.75 parts of ether and 43.25 of chloroform mixed together. By taking 83 per cent. volume of this molecular solution and mixing with it 17 per cent. volume of ethyl chlorid, the anesthetic, "anesthol," with a boiling point at 40 C., is produced. This represents 17 per cent. of ethyl chlorid, 35.89 per cent. of chloroform and 47.10 per cent. of ether. Meyer assumes that Schleich's reasoning as above mentioned is correct, consequently he believes that nearly all of the anesthetic inhaled with each inspiration is exhaled with each expiration, with the result that almost none is retained in the blood. After all the main question is, what are the practical results with a given anesthetic?

Meyer bases his recommendation of the use of anesthol on his experience with it in "many hundreds of cases operated on during the last 4 years." In this series of cases there was one death on the table directly attributable to the effects of the anesthetic. In this case it appears that respiration and circulation ceased suddenly, as in some forms of chloroform syncope. Meyer states that in all of the surviving cases in which dangerous symptoms occurred, it was the respiration and not the circulation which was especially affected. The anesthesia under anesthol is said to be tranquil, the circulation excellent and, when carefully administered, the respiration easy—much the same as with the original Schleich mixtures.

In my judgment, the great objection to the use of anesthol is that it contains chloroform—and a large proportion of it. Whether the ethyl chlorid contained adds to its toxicity must be decided by further experience with ethyl chlorid as a general anesthetic. Theoretically, I would consider Schleich's ethyl-chlorid-chloroform-ether mixture, above mentioned, decidedly less dangerous than anesthol, owing to the vastly smaller

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amounts of chloroform and ethyl chlorid contained in the former. Schleich's statistics with his latest mixture show far better results than do Meyer's with anesthol. I do not expect either of these mixtures to attain and maintain the high regard of surgeons in general, nor do I believe that any form of chloroform mixture can be made as safe for administration in routine work as ether.

The administration of morphin before or during an anesthesia by ether or chloroform to produce a mixed anesthesia is sometimes a distinct advantage. Morphin given before chloroform is likely to prevent the dangerous nasolaryngeal reflex and the "stage of excitement." Atropin given before ether administration very materially reduces the excessive secretion of mucus produced by the ether and is a distinct advantage. A hypodermic injection of morphin and atropin, then, before ether or chloroform anesthesia is good practice. Atropin as a cardiac stimulant tends to counteract chloroform depression. In operations about the face, where it is difficult to maintain complete anesthesia with ether or chloroform, a full dose of morphin is a great aid, as it adds to the analgesia and at the same time permits the patient to be sufficiently awake to clear the mouth and throat of blood. Chloral, alone or combined with morphin, is used by some for the same purpose. Chloral is distinctly a cardiac depressant and should not be used with chloroform. The same may be said of cocain, which was used in this way by Obalinsky. Chloretone is recommended as an ante-operative hypnotic and antinauseant. It is questionable if it should be employed for this purpose, as, according to some observers, it is a cardiac depressant. William Rush Dunton[29] reports 9 cases of the continued use of chloretone. In all but 1 unfavorable action on the heart and kidneys was observed. He thinks the main disadvantageous action is as a heart depressant.

29. American Journal of Insanity, July, 1901.

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SUCCESSIONS OF ANESTHETICS.

By this term is meant the induction of anesthesia with one anesthetic and its continuance with another.

Ether-Chloroform.—This method of anesthesia is often employed in operations about the face and its cavities, where partial or "talking anesthesia" is desirable. Giving the ether first reduces the amount of chloroform required, and the narcosis is more readily maintained with chloroform than with ether.

Chloroform-Ether.—This method is a favorite with a large number of surgeons. Primary anesthesia is induced with chloroform, which saves time and is less disagreeable to the patient, and the narcosis continued with ether.

I have at my disposal the histories of 4,500 cases anesthetized by this method. These anesthesias were in the service of A. J. Ochsner in the Augustana Hospital, Chicago. The average time required to produce unconsciousness was about 7 minutes; average time for surgical anesthesia about 10 minutes; average duration of narcosis, 46 minutes; longest narcosis, 3 hours; average amount of chloroform used, about 12.5 c.c., and of ether, 180 c.c. In the first 200 cases, the paper and towel cone was used for ether; in all the other cases the Esmarch chloroform mask was used for both chloroform and ether. With the cone, the average amount of ether used was much greater than with the "open" mask, owing to a large amount of ether not evaporating from the cotton in the cone. The operations in this series included about 1,800 celiotomies, including herniotomies; 620 major and minor gynecologic operations; 180 amputations; and 1,900 miscellaneous operations on bones and soft tissues. Artificial respiration was required in about 1 per cent. of the cases, failure of respiration occurring in most cases at about the termination of the primary chloroform anesthesia or just after ether had been substituted. In the majority of cases it seemed to be due to too rapid administration.

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On analysis of the danger cases, in which accurate observations were made (all occurring during the primary chloroform inhalation), I find that the circulation failed in 80 per cent. of them before respiration became perceptibly affected. In about 50 per cent. of the danger cases the observations were not sufficiently accurate to base conclusions on. In these cases the respiration was noticed to cease, while on immediate examination the patient was also found to be pulseless. In one case general muscular twitchings occurred and the respiration ceased while the heart remained undisturbed. One death occurred. The patient was 38 years of age and in poor general condition. The operation was to have been for carcinoma of the ovary, 3 c.c. of chloroform and 8 c.c. of ether were used. Chloroform had been given for 4 minutes when ether was substituted, and in a half minute more respiration suddenly ceased. Artificial respiration was continued for 3 hours and 10 minutes, during which time the heart continued to beat. There was cyanosis, but no struggling. In 100 of the cases the condition of the urine before and after anesthesia was recorded. In 5 per cent. of these cases an existing albuminuria was increased, and in 3.5 per cent. albumin was found after the narcosis when before it was absent.

Nitrous Oxid-Ether.—This method has become popular in both the United States and Europe, especially in England. The advantages of the method are: 1, the time required to produce anesthesia is reduced to from 2 to 5 minutes; 2, the discomfort to the patient is reduced to the minimum; 3, the nausea and vomiting following etherization are reduced. About the only real disadvantage has been that, on account of the apparatus required, the method was practically limited to hospital practice. However, its mode of administration has been so simplified that the cumbrous inhaler can be dispensed with.[30] An ordinary paper and towel cone open at both

30. Albert H. Miller: Annals of Surgery, 1899, vol. xxx, p. 709.

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ends may be used instead of the closed inhaler. This reduces the danger of asphyxiation and is cleanly and inexpensive. This method of producing anesthesia approaches the ideal when the open method of administration is employed and the ether given drop by drop. With this method there is less change in the conditions to which the body is normally subject than results from any other form of anesthesia.

Nitrous Oxid-Ether-Chloroform.—This method of anesthesia is advised by Frederick W. Hewitt.[31] He bases his recommendation on these grounds: The gas makes the anesthetization easier and pleasanter for the patient; the ether can be administered during the chief part of the operation, and gives the anesthetist little concern, whereas chloroform produces greater quiet and muscular relaxation, and during the administration there is also a comparative freedom from venous engorgement. The danger from chloroform is during the second stage—that of excitement—which is avoided by the employment of this method. The disagreeable after-effects of ether are also avoided. This method is highly commended in operations about the mouth, throat and nose.

Ethyl Bromid-Ether.—This method is being tried somewhat extensively. The chief advantage of the method over the nitrous oxid method is that no special apparatus is required. Four fluid grams (1 fluid dram) of ethyl bromid is poured into a folded piece of gauze held in the palm, over which the fingers are partially flexed, forming a cone, and this is applied closely over the patient's nose and mouth so as to exclude air. Unconsciousness occurs on an average in 40 to 60 seconds. Ether is then substituted, and there is usually little disturbance when the change is made. In from 2 to 4 minutes more the anesthesia will be complete. Less ether is required than in pure ether narcosis, by the amount necessary to produce unconsciousness.

31. Gould's American Year Book of Med. and Surg., 1902, p. 48.

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I have tried ethyl bromid-ether anesthesia in a few cases, with results about like the above mentioned. I am, however, unable to convince myself that ethyl bromid is not much more dangerous than nitrous oxid, consequently do not expect to employ the method again unless many thousands of administrations by others shall have demonstrated beyond reasonable doubt that it is as safe as nitrous oxid. There is not sufficient advantage in the ethyl bromid-chloroform method to warrant its employment.

Chloroform-Oxygen.—This method is probably safer than the ordinary chloroform method, but it is difficult to believe it is as safe as Heinz Wohlgemuth[32] implies when he says that he thinks overdose with this method is impossible. He reports 300 narcoses by the method. He uses an elaborate apparatus—in itself an objectionable feature.

CHLOROFORM AND AMYL NITRITE.

During the Civil War this mixture was used very extensively. Four grams (1 dram) of amyl nitrite is added to 1 pound of chloroform. The object is to reduce the danger of chloroform narcosis. The amyl nitrite perceptibly diminishes the cardiac depression of chloroform and improves the capillary circulation, as shown by less pallor. Cyanosis is less frequent than when pure chloroform is used. After observing its use by another surgeon (N. Senn) in a large number of cases I decided to try it. Its use in a few cases convinced me that the mixture is very much less safe than ether, though probably safer than chloroform alone.

PARTIAL OR TALKING ANESTHESIA.

This method is employed in bloody operations about the nose and mouth, instead of complete narcosis and Rose's (head down) position, to prevent blood from entering the trachea. A half hour before beginning the administration the patient is given 2 ounces of whisky

32. Interstate Med. Jour., St. Louis, October, 1901.

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or brandy in water, or 15 minutes before, a full dose of morphin hypodermically. The patient is placed with the head and shoulders somewhat elevated and the anesthesia carried only far enough to blunt or abolish the pain-sense, but the patient should remain sufficiently conscious to respond to questions and co-operate with the surgeon in clearing the mouth and throat of blood. This method does away with the necessity for preliminary tracheotomy in certain operations above the larynx. A great objection to Rose's method is that with the head dependent bleeding is greatly increased. "Talking" anesthesia should not be used indiscriminately. In many cases the pain-sense can not be sufficiently blunted short of surgical narcosis, and in some cases the shock produced by the pain, added to that of the operation and the exhaustion caused by struggling, may determine the death of the patient. Also the liability to apoplexy is increased by the struggling. Many of these patients have no recollection of pain during operation, while others say they suffered terribly.

Primary anesthesia may be advantageously employed for short operations—like the removal of adenoids, breaking up of ankyloses, thoracotomy, etc. Ether, and not choloroform, should be used, since in chloroform narcosis the time of greatest danger is during the moment when relaxation is occurring, just previous to the beginning of surgical anesthesia.

Nitrous oxid is the best anesthetic for short operations, but it should not (as is often done) be administered with the patient in the upright position, especially for operations about the pharynx, where blood or tissues are liable to be aspirated into the trachea.

HYPNOTIC ANESTHESIA.

This form of anesthesia has been in use for many years, and several hundreds of painless capital operations have been performed under its influence. The method is uncertain, in that the hypnotic sleep can not be produced in all individuals; and even susceptible in-

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dividuals must, as a rule, be subjected to a series of daily hypnotizations before operation. This method of producing anesthesia is not free from danger, since death may occur under hypnosis. There are other obvious objections to the use of the method. I believe it should be employed only exceptionally.

ANESTHETICS AND INSANITY.

Any drug capable of producing temporary mental disorder may cause permanent aberration. While anesthetics may cause insanity, they rarely do so, excepting in those who have had it, or are specially predisposed, and when insanity follows anesthesia it may be due, in part, to the operation. In a patient liable to recurrent insanity anesthesia is dangerous, and it may cause redevelopment of a waning mental trouble. According to G. H. Savage[33] melancholic and delusional insanity seldom occur, but stupor prolonged for weeks does occur, and bladder or rectal operations appear to enhance the risk. There is little or no danger in anesthetizing a patient already insane, and there is little difference to be expected from the different anesthetics.

PARALYSIS FOLLOWING ANESTHESIA.

The terms "anesthetic paralysis" and "postanesthetic paralysis" are misleading, as a rule, because they lead to the erroneous conclusion that the condition is produced by special action of the anesthetic agent. Paralysis following anesthesia is nearly always due to direct or indirect pressure on or stretching of nerves during anesthesia (including those cut or otherwise injured by the operation), though it is occasionally central in origin—apoplexy, embolism. The irritability of peripheral nerves is often increased (in alcoholics especially) so that slight pressure produces numbness in the distribution area, and if continued, paralysis. These paralyses or pareses usually occur in the upper extremities, and are preventable. The usual causes are: Tight con-

33. Brit. Med. Jour., Nov. 18, 1899.

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striction of the extremity, as by an Esmarch bandage (easily avoided by padding smoothly over the nerves before applying the constrictor, and using reasonable judgment as to the force applied); continued elevation and extension of the arm, causing the head of the humerus to press on the brachial plexus; tight straps around the extremities or shoulders; keeping the arm under the head or body, or allowing an extremity to hang over the edge of the table, and in various other ways. In many cases recovery occurs within a few days, but in others the paralysis lasts for months or years, even permanently. In these cases, medicolegal questions are liable to arise as to the liability of the surgeon.

ANESTHESIA IN HEART DISEASE.

As a rule, it is only in myocardial affections that anesthetics produce any markedly bad effects. In myocarditis ether is badly borne, and chloroform is dangerous in the extreme. In valvular disease, while there is appreciable disturbance, it generally is not great, and in functional affections the effects of anesthetics are insignificant.

In cardiac disturbances after anesthetics it is often difficult to determine whether the result is due to the anesthetic or to the operation. In some cardiac diseases ether has a temporarily beneficial effect, although the secondary effect may be unfavorable, the symptoms occurring after a lapse of days, perhaps. Ether is contraindicated in the presence of arteriosclerosis and high arterial tension. Nitroglycerin would tend to counteract this danger.

Local and regional anesthesia have been suggested as being preferable to general anesthesia in heart disease. I believe that the nervous tension and shock attendant upon any serious operative procedure under local anesthesia often more than counterbalance the advantages obtained, as compared with general anesthesia, in these cases. That is, as a rule, general anesthesia is preferable to local or regional anesthesia for serious operations

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in cases of heart disease. Few persons die from heart disease while under anesthesia, and the anesthetic is not always blamable for those deaths which occur. Such patients are liable to die at any moment, even when asleep in bed. The effect of an anesthetic may, of course, show itself as a postanesthetic edema or pneumonia in these cases. No condition of the heart is an absolute contraindication to the use of an anesthetic, and ether is the anesthetic of choice.

ANESTHESIA IN THE PLETHORIC AND OBESE.

Plethoric persons are poor subjects for most anesthetics; consequently, the anesthetizer must observe great care in selecting and administering the anesthetic. The chief difficulty encountered is with the respiration. Hewitt observes that the boundary parts of the upper air passages may, in vascular subjects, become so engorged as to lessen the capacity of these passages, and that this turgescence is most pronounced under nitrous oxid or ether, but may occur with other anesthetics. It is best to keep florid persons deeply anesthetized, in order to avoid the occurrence of troublesome reflex phenomena. I believe that a judiciously selected sequence of anesthetics in these cases will afford fully as happy results as can be obtained in any other way. "Obese subjects are, as a rule, intolerant of any anesthetic which, by reason of the method of administration employed, materially curtails the supply of air" (Hewitt). This, of course, would indicate the use of those agents which can be administered by the "open" method, and to employ only that method.

TEMPERATURE CHANGES DURING ANESTHESIA.

All anesthetics tend to lower the body temperature, and the longer the narcosis the lower the temperature and the longer in recovering to normal. Depression of the nervous system and lowering of blood-pressure correspond closely to loss of heat. Ether causes profuse sweating, which, of course, lowers the tempera-

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ture, the temperature also being lowered by evaporation of the ether. Atropin is useful in these cases as a vaso-motor stimulant. The temperature may be lowered by anesthetics over 3 F. Loss of heat may be, to a great extent, prevented by properly covering the patient, by surrounding him with hot bottles, and by being careful to have the operating room at the right temperature (75 to 85 F.)

ANESTHETICS IN OBSTETRICS.

The writer's experience along this line is that in a quite large proportion of cases chloroform lengthens the intervals between pains, shortens the duration of pains and diminishes their force, and this occurs when only small amounts of chloroform are given at the beginning of each uterine contraction—scarcely enough to produce momentary unconsciousness. In some cases the labor is almost arrested for the time. That there is danger to the child in prolonged anesthesia during parturition there is no doubt; therefore, anesthetics should be given in as small quantities as possible. Fortunately, very little anesthetic is required to control the worst of the pain of labor, and, given a few drops at a time at the beginning of each uterine contraction, it is an inestimable boon in most cases. Ether is the anesthetic of choice in labor for either partial or complete anesthesia, being less dangerous than chloroform and practically as efficient.

RECTAL ETHERIZATION.

This seems to have been first suggested by Roux, in 1847, and it was practiced by Pirogoff on the human subject in the same year.[34] It may be administered by immersing the bottle of ether in water at a temperature of about 120 F., and connecting it with the rectum by means of a rubber tube. After 5 to 10 minutes, a taste of ether is experienced by the patient, and drowsiness quickly follows. A fatal case was published by Wier

34. Anesthetics and Their Administration, Hewitt, 2d ed., p. 285.

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(1884), in which there was depression, followed by melena, and death within 24 hours. W. T. Bull[35] published 17 cases, and in 7 of them melena occurred. Manifestly, the chief advantage of this method of anesthesia would be in operations about the mouth and nose. It would seem too dangerous to employ in any but exceptional cases.

INHALERS.

There is a multitude of ether and chloroform inhalers on the market, some modeled for the "open method," others for the "closed method" of administration. The Esmarch chloroform mask and the Allis ether inhaler are types of the former, and the Clover and the Ormsby ether inhalers and the Junker chloroform inhaler of the latter. The advantages of the Clover inhaler are well presented by G. Gordon Campbell of Montreal.[36] His description of the inhaler is taken from Joseph Mills' article on anesthesia in Treves' Manual of Surgery: "The inhaler consists of a face-piece, with an indicator, which, by rotation, may be made to point to 0, 1, 2, 3, or F., on the circumference of a metallic vessel containing fluid ether; and of a bag, into which and from which the patient breathes. It is so constructed that when the indicator is at 0, the expired and inspired air passes to and from the bag, without in any way communicating with the ether-chamber. If the indicator stands at F., the whole of the expired air must pass through the ether-vessel to the bag, and at inspiration return from the bag through the ether-vessel. When the indicater is at 2, half the inspired air passes through and from the bag direct, the other half passes through the ether-vessel, and so on for the other numbers. The air does not pass through the ether, but simply the vessel containing it, and this is sufficient to carry off a large amount of vapor." Perhaps the chief so-called advantage claimed for this class of inhalers is that the amount

35. Medical Record, May 3, 1884.
36. Annals of Surgery, vol. xx, p. 626.

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of ether inhaled can be accurately regulated. There also is a great saving in the quantity used, compared with the "open method." The asphyxial element enters largely into the production of anesthesia when the "closed" kind of inhaler is used. I believe this adds to the danger. I discard this class of inhalers, as they are dangerous, cumbrous, expensive, and filthy. Take the Clover inhaler, for example. The patient's microbe-laden breath, to say nothing of its other constituents, is passed through the entire apparatus repeatedly, the face-piece is befouled with mouth secretions, stomach contents, etc., and this process is repeated time after time indefinitely. It is practically impossible to asepticize these inhalers, and even if this can be done, certain disagreeable odors can not be eliminated. Possibly, some of the pneumonias attributed to ether can be accounted for in this way. The Junker inhaler is so constructed that the inspired air is charged with chloroform vapor by being forced, by means of a hand-bulb, through the liquid chloroform, after which it reaches the face-piece through a rubber tube. The percentage of chloroform in the inspired air is regulated by the depth of chloroform through which the air passes. Some 12 years ago I employed this apparatus in a few cases—and it has ever since been an especial source of comfort to me that none of the patients died from its use. Only an expert can use the elaborately constructed appliances, and with some of them, like the Junker inhaler, two persons are necessary in order to conduct the anesthesia properly. The paper and towel cone, closed at one end, is open to the following objections: The supply of ether can not be properly regulated; the patient is apt to be asphyxiated into insensibility; the ether vapor is not sufficiently nor constantly diluted with air, and the method is wasteful.

The best type of inhaler, for ether and for chloroform, is one made on the principle of the Esmarch chloroform mask. Lawrence H. Prince of Palmyra,

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Wis.,[37] introduced this method in Chicago in 1895. It answers the purpose in most cases where ether can be used. The evaporating surface should be somewhat larger for ether than for chloroform, and the covering of gauze should consist of fully twice the number of thicknesses. In high altitudes and when the atmosphere is very warm, the mask should be modified, so as to allow its sides to be covered with a less pervious material —as in the mask devised by Nicholas Senn. Ernest Laplace has still further modified the Esmarch inhaler by covering the cone with metal, leaving ample opening at the top for air. All things considered, the Laplace inhaler is, perhaps, the best on the market. This kind of inhaler is cleanly, since fresh gauze is supplied for each case; it is efficient and safe, and the admixture of air can be easily regulated. I have modified the Laplace inhaler by having attached to the left side a ring for the thumb, which makes it easier to retain in place. The Esmarch or the Schimmelbusch masks can be made practically like the Laplace mask by covering the gauze with oiled silk or other impervious tissue, leaving an opening at the top.

Edmond Souchon of New Orleans[38] devised an apparatus whereby ether or chloroform can be administered through a nasal tube, passed down until it is opposite to the glottis. This device enables a surgeon to operate about the face and neck, with the patient under continuous anesthesia, and with the anesthetist and his apparatus out of the way.

TONGUE FORCEPS AND GAG.

A medium-sized double vulsellum will do less harm if properly used than the ordinary tongue forceps. The former simply makes two punctures, while the latter frequently lacerates and contuses the tongue. N. Senn has devised a tongue forceps, consisting of a lower, flat, fenestrated blade, with an upper, single tenaculum blade.

37. Chicago Medical Recorder, April, 1897.
38. THE JOURNAL Am. Med. Assn., Dec. 29, 1894.

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I have modified this forceps by having a double tenaculum blade above and a heart-shaped blade below, instead of the pointed one. (Senn has recently changed his forceps to a double vulsellum.) Usually, however, the tongue can be grasped and held with a piece of gauze, thus avoiding injuring it. When the tongue is being held, a gag is required; in general, the gag can be dispensed with at other times. In a large proportion of cases it is, as ordinarily used, positively detrimental, since by forcing the jaw downward and backward, it causes obstruction to respiration. It should be used only when especially indicated, and not in a routine way. The best gag to use during anesthesia is either a piece of hard wood, 10 to 15 cm. (4 to 6 inches) long, 2.5 cm. (1 inch) wide, and 6 mm. (¼ inch) thick, with edges and corners rounded; or the one consisting essentially of a triangular piece of soft rubber, with a metallic handle, devised by John W. O'Neill of Chicago. I want to emphasize the fact that an expert anesthetizer seldom uses the tongue-holding forceps or the gag.

SELECTION OF AN ANESTHETIC.

In order to receive favorable comparative consideration, an anesthetic should possess these qualities: Immediate and remote safety; least disagreeable to take; best calculated to quickly produce and maintain muscular relaxation, followed by the minimum of ill effects, as vomiting, depression, respiratory troubles, renal disturbance; minimum influence on the question of hemorrhage; best adapted to the individual case. In the vast majority of cases the choice lies between ether and chloroform. It has been proven beyond reasonable doubt that, all things considered, chloroform is more dangerous than ether, both immediately and remotely. The immediate safety (during administration) is so overwhelmingly in favor of ether that I do not hesitate to assert that those who hold to the contrary can not be fully acquainted with the facts. There are really very

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few contraindications to the use of ether when skilfully administered by the "open" method. It is not strongly contraindicated, even in ordinary cases of chronic nephritis, nor in any but acute or severe bronchial affections. In the presence of asthma or of acute bronchial affections, marked arteriosclerosis or atheroma, ether is more dangerous than chloroform, as a rule. Atropin will, to some extent, prevent the danger in the first two conditions, and amyl nitrite or nitroglycerin in the last two. Although formerly (for ten years) a chloroform advocate, I have learned from experience, careful observation, and the study of recent investigations, to use chloroform only where it is especially indicated—and that is extremely seldom. The safety margin between sufficient ether for anesthesia and the lethal dose is much greater than with chloroform. Ether is much safer for indiscriminate use, in that most physicians who administer anesthetics are relatively unskilled in their use. In order to reduce the bad effects of an anesthetic to the minimum, it must be skilfully administered; and when the anesthetic is badly given, the dangers from chloroform are very much greater than those from ether. Ether kills slowly, generally by its effects on respiration, and usually gives ample warning of danger, since the heart continues to beat long after respiration ceases. Chloroform kills quickly, generally by its effect on circulation, and is very likely to afford no warning of danger. Ether is safer in healthy persons than in the weak and prostrated, while chloroform is often as dangerous in the vigorous as in the debilitated. Treatment usually promptly overcomes unfavorable symptoms from ether, and often does no good in those from chloroform. Public opinion in most parts of this country is overwhelmingly in favor of ether, as compared with chloroform; hence, if an accident happens with ether the surgeon is much more likely to escape blame. As mentioned by Treves,[39] the objection urged against ether,

39. Practitioner, London, October, 1896.

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that it produces venous engorgement, and, consequently, too much oozing from the field of operation, is not well founded, the question being chiefly one of administration.

In tropical climates and in very high altitudes, chloroform is used almost exclusively. The Hyderabad Commission reported that it was almost impossible to give sufficient ether to an animal without producing asphyxia, on account of its rapid diffusion in that climate. Similar difficulty is experienced to some extent in high altitudes. Chloroform appears to be considerably less dangerous in these climates than in low altitudes and temperate or cold climates. This probably is due to the warm, uniform temperature in the tropics, and the lighter atmosphere of high altitudes, favoring quick action of chloroform, and its rapid and even elimination. Neve[40] states that there is good evidence that the chloroform death rate in India is not more than one to 8,000, and in some of the larger hospitals it is one to 20,000.

General Statistics.—The statistics of deaths from anesthetics can not be relied on as indicative of the actual dangers encountered. They represent the deaths only, and not the narrow escapes. Moreover, in this country, and in some others, it is probable that not half the deaths from anesthetics are reported. James Edmonds[41] states that in 1899 there were eighty-three inquests on persons who died in England from anesthetics. Of these, sixty-eight died before the operations were commenced. He estimates that some 200 persons died in England during 1899 from anesthetics, basing the estimate on the ground that there is a tendency to have few inquests in these cases, and that often the reports of such inquests are suppressed. Dr. F. C. Gram,[42] Registrar of the Buffalo (N. Y.) Board of Health, states that he has recorded over 40,000 deaths, only three of them certified as due

40. British Med. Jour., Nov. 5, 1898.
41. Lancet, London, Jan. 27, 1900.
42. American Medicine, vol. i, p. 16.

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to anesthetics, while he has personal knowledge of more than four times that number of deaths under anesthesia during the same period, but they were certified as due to other causes.

The statistics presented at the Thirtieth German Surgical Congress, Berlin, May, 1901, credit chloroform with a death rate of one in 2,023; ether, one in 5,090; ethyl bromid, one in 5,228.

Gurlt's statistics up to 1893, based on 157,815 war cases, give a death rate for chloroform of one in 2,899; chloroform with ether, one in 41,181; ethyl bromid, one in 4,588; pental, one in 199. No deaths from ether or A.C.E. mixture reported.[43]

A. I. Bouffleur[44] quotes statistics of over 1,000,000 chloroform and over 500,000 ether anesthesias, in which the average chloroform mortality is one in 3,355, and the average ether mortality one in 16,768.

In considering statistics, we find that the personal equation is of the greatest importance. One man has 15,000 chloroform cases, with only one death, while another has three deaths in less than 1,000 cases. One selects his cases for chloroform, while another gives it indiscriminately. One administers an anesthetic carefully by the open method; another gives it carelessly by the closed or the smothering method. It is notable that by far the greater number of deaths are reported from localities where chloroform and pseudo-scientific, complicated inhalers are extensively employed. I quote from an article in *The British Medical Journal* of the late '90's: "In a certain institution in Great Britain, in the course of a recent year, there were, out of some 3,000 or 4,000 administrations, no fewer than twelve fatalities from chloroform." Taking the higher number of anesthesias, this means one death in every 333 administrations.

43. Practical Surgery, Senn, 1901.
44. Chicago Medical Recorder, May, 1897.

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German statistics during the decade 1890 to 1899, show deaths about as follows:

Ether, one in 7,000; chloroform, one in 2,000; ethyl bromid, one in 4,000; pental, one in 2,000; chloroform-ether, one in 9,000; A.C.E., one in 6,000.

Ziegler's statistics give the death rate of chloroform as one in 1,900 and of ether as one in 26,000.

Chaput gave it as one in 2,000 and one in 13,000, respectively.

Foy's statistics, based upon 877,507 chloroformizations and 314,738 etherizations, give a mortality of one in 4,301 and one in 14,987, respectively (Sajous' Annual).

Poncet had but one death in 29,000 ether anesthesias. He believes the danger is from asphyxia.[45]

It is interesting to note that in one year, of forty-one recorded deaths from chloroform syncope, thirty-nine occurred during the primary stage of anesthetization and before the surgeon had touched the patient. In a series of 6,000 narcoses in a Chicago hospital, there were three deaths—two from chloroform and one from ether. The first of these deaths occurred in case No. 3,183, consequently all were in the second 3,000 cases. The majority of the first 3,000 narcoses were supervised by specially skilled anesthetists, while a majority of the last 3,000 were in the hands of less experienced anesthetizers. The patient who died from ether was 45 years of age and in good general condition. The operation was amputation of the breast for carcinoma. Induction of narcosis required 18 minutes and the narcosis lasted 77 minutes. Amount of ether used, 380 c.c. After the operation the patient became very cyanotic, and died one hour after the termination of the narcosis. Everything in the way of resuscitation was tried, excepting tracheotomy. This should be tried when other means of resuscitation from asphyxia fail. The chloroform patients who died be-

45. Progressive Medicine, December, 1902, p. 78.

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came cyanotic at the end of the primary stage of anesthesia, and at the same time were found to be pulseless.

The Committee of the British Medical Association have completed their report on 25,920 carefully considered anesthesias.[46] Chloroform was employed in 13,393; ether in 4,595; nitrous oxid in 2,911; gas and ether in 2,071; A.C.E. mixture in 678; nitrous oxid with oxygen in 597; chloroform and ether in 418; chloroform, followed by A.C.E. or other mixture, in 275, and A.C.E. mixture, followed by ether, in 155. Unusual symptoms either accompanied or followed the anesthesia in 733 cases. There were twenty-nine deaths, eighteen of them occurring under chloroform. In considering the cases of danger (including deaths) which were attributed entirely to the anesthetic, the committee found that the chloroform group gave an average danger-rate of 0.584 per cent., while the ether group gave a danger-rate of 0.085 per cent. About twice as many danger-cases occurred in the males as in the females, and danger to life occurred more especially in the early period of administration. Chloroform was found to be more dangerous at ages below 10 and above 30 than in the intermediate period of life. Imperfect anesthesia was the cause of a large number of cases of danger under chloroform.

Mixed anesthetics should, in general, be avoided, for when trouble occurs the anesthetizer can not always know which of the constituents is causing it, and, consequently, he is hampered in his treatment of the emergency.

In the presence of postnasal adenoids, especially if hypertrophy of the faucial tonsils also be present, I consider chloroform extremely dangerous. Nitrous oxid—with the patient in the recumbent posture—is the best anesthetic for these cases, and ether, to the stage of primary relaxation, the next best.

Many of the sudden deaths under anesthesia, especially of children and young persons, have occurred in

46. Gould's Am. Year Book of Med. and Surg., 1902.

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the presence of a persistent, or even hypertrophic, thymus. In most of such cases the spleen and tonsils are unusually large, and enlargement of the follicles at the base of the tongue is constant (L. Laquer, Strassburg).

In considering the question of choosing an anesthetic, Mikulicz of Königsberg thinks it somewhat doubtful whether a general anesthetic should be used at all, in view of the recent advances made in local and neuroregional anesthesia. I think it probable that general anesthetics will always be used, for the reasons that unconsciousness is best in very many cases; muscular relaxation can not be secured in any other way, and, in general, time is saved.

PREPARATION AND ADMINISTRATION.

Hewitt strikes the right chord when he says: "The giving of an anesthetic is purely a practical matter, and no one is competent to express an opinion on how it should be given who has not himself had personal experience in the operating room." One vital point which militates against the practical value of such experiments as those conducted by the Hyderabad Commission, for example, is that in anesthetizing sick human beings factors come into play which are not met with in healthy animals. Consequently, we must be wary about placing full confidence in deductions drawn solely from laboratory experiments. The anesthetizer is, in a way, subservient to the surgeon, yet in many cases it requires vastly more skill to manage the anesthesia than it does to perform the operation in hand. The custom of relegating the administration of the anesthetic to the least experienced of the physicians present at an operation is rapidly giving way to more rational practice. No one who has not a wholesome fear of anesthetics can become a skilful and safe anesthetizer. The skilful anesthetist recognizes that in giving the anesthetic he accepts a great responsibility, and can not safely attend to anything else, nor watch the operation, save to be cognizant of its stages.

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He must be on the alert every instant for danger signals, and he should be able to manage complications when they arise. I do not know of a more trying situation than when a surgeon has to closely watch or direct the anesthesia and do a dangerous operation at the same time. The art of becoming a skilful anesthetizer is only acquired by careful study of details, and with large experience.

Preparation.—All patients who are to be subjected to anesthesia should, if possible, have the benefit of at least two or three days' preparatory treatment and observation. The organs of elimination—the bowels, the kidneys and the skin—should be put in the best possible condition. The urine should be examined carefully for evidences of nephritis or diabetes, so that precautions may be taken where necessary. The condition of the cardiovascular system and of the lungs should be carefully determined, and the patient's habits, as to alcohol, tobacco, and narcotics, inquired into. In patients with any pronounced symptoms of anemia a blood examination should be made. When the percentage of hemoglobin is under 40, no operation should be performed save in great necessity, on account of the destructive action of anesthetics on the erythrocytes. The food for as long a time as possible before the operation should be of the most nutritious and easily digested kind suitable for the patient, and the feeding should be rather forced than otherwise, especially in delicate persons, up to the day preceding the operation, in order to bring the vitality to the highest available point, thus enabling the patient to better withstand the shock of the operation and the anesthetic. The day preceding the anesthesia the diet should be nutritious and light—either liquid or semiliquid. No solid food or milk should be given within several hours of an anesthesia, but water should be allowed to within say two hours preceding it; and a cup of beef tea or one of coffee, or both, taken from one to two hours before the administration, are valuable for their stimulating

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and sustaining effects. The system should be well supplied with fluids before and after anesthesia. "All the functions of the body are carried on in a fluid medium." Without abundance of this medium, we may not expect as rapid recovery from the effects of the anesthetic and operation as can be obtained with plenty of it. For the bowels, I favor a brisk cathartic—preferably castor oil—to be given at least 24 hours before the anesthetic is administered. An enema may be given a few hours before the anesthesia. This plan allows the patient an opportunity to sleep the night preceding the operation, and does not leave the system depleted of its fluids; consequently the patient is not so apt to be tormented with thirst and nausea after the anesthesia, and the anesthetic and waste products are more readily eliminated. The best time to administer an anesthetic is in the early forenoon, the time of day when most persons are at their best. The patient should be dressed with a view to the nature of the operation, so that no unnecessary disturbance will be required after administration is begun. The neck, chest and abdomen should be perfectly free from pressure. Bearing in mind that anesthetics lower temperature, the patient should be protected sufficiently to prevent great loss of body heat. The temperature of the operating room should be from 75 to 85 F., according to altitude and dryness, a moist, low atmosphere not requiring as high temperature as the opposite conditions. The temperature of the room should never be over 85 F., since in very high temperatures heat prostration is added to the shock of the operation and the anesthetic. The mouth should be freed of all loose substances. Cocainizing the nasal mucous membrane to prevent reflex disturbances of the pneumogastric and respiratory nerve center in the medulla from irritation of the sensory terminations of the trigeminus distributed in this membrane, is open to the objection that cocain constitutes an added danger. Preliminary inhalation of a few drops of peppermint oil will answer the purpose.

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W. A. Briggs[47] advocates the use of oil of peppermint or menthol preliminary to etherization. About a dram of the oil or of a 50 per cent. alcoholic solution of menthol is sprinkled in the inhaler and the patient allowed to inhale freely for three minutes, then etherization is pushed as rapidly as is consistent with safety. The seeming advantages, as compared with the usual method, are: 1. The anesthesia may be more easily and quickly induced, and more smoothly maintained; 2, entire absence of coughing and suffocation, and comparative freedom from nausea, vomiting and retching; 3, suppression or marked abbreviation of the period of excitement; 4, profounder first anesthesia, which permits minor operations with greater certainty; 5, less post-anesthetic nausea.

During the past few months this method has been followed in my practice with excellent results. It deserves extensive trial. In etherizing a 4-year-old boy, recently, the transition from peppermint to ether was unnoticed, and there was no stage of excitement.

As a further preliminary to the administration of ether, a hypodermic injection of morphin, 1/12 to ¼ gr., and atropin, 1/200 to 1/100 gr., is of value, the former to quiet the patient and the latter to prevent excessive secretion of mucus and profuse sweating. These drugs are best administered 15 to 30 minutes before beginning the administration. It is good practice to give a full dose of strychnin before a prolonged narcosis or in the debilitated.

Administration.—It is of the utmost importance that before beginning the administration of an anesthetic the anesthetizer gain the confidence of the patient, and thus be enabled to allay fears which have been conjured up perhaps days or weeks in advance. In persons of average intellect and education the difficulties are not generally great, but in the ignorant, especially if very nervous or hysterical, it is occasionally impossible to

47. Occidental Medical Times, April, 1902.

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allay the apprehensions of real or imaginary dangers. I find that the greater the fear preceding anesthesia, the greater the danger during the narcosis. It is best to anesthetize the patient in a room free from noise, and do no talking, excepting to the patient, while inducing the narcosis; and the anesthetizer should invariably have someone within easy reach to aid him in case of emergency. There should be as little disturbance and lifting of the patient as possible after the anesthesia has begun, so as to avoid disturbing the anesthesia in its early stages. During the past two years I have followed the custom of William J. and Charles H. Mayo of Rochester, Minn., of having patients anesthetized in the operating room on the operating table.[48] I then have them under my own eye from the beginning of anesthesia, and there is no disturbance or loss of time due to changing from cart to table. Before beginning the administration the anesthetizer should carefully observe the pulse, respiration, pupils, color of skin and lips, and the general condition of the patient, mental and physical. The position of the head should be determined by the degree of cervicodorsal curvature. It should rest either on the table, the patient being recumbent, of course, or slightly elevated on a firm pillow, in such a way as to relax all the tissues of the neck and permit the greatest freedom in breathing. The eyes should be covered with wet gauze or cotton during the administration, in a manner which will permit ready inspection. Everything the anesthetist may require during the anesthesia should be at hand before the administration is begun. A most important matter is the management of the jaw. From the first it should be kept well forward, making it impossible for the patient to "swallow the tongue." A good method of keeping the jaw forward is to place the thumb on the malar prominence with the middle or ring finger pressing from behind forward (not from below

48. Alice Magaw, "The Administration of Anesthetics," St. Paul Med. Jour., January, 1902.

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upward) on the posterior surface of the angle of the jaw, and as relaxation of the muscles occurs with approaching narcosis, the lower teeth are hooked in front of the upper. At the same time the head is rotated to the right and slightly extended. This position removes the influence of gravity on the jaw, while at the same time offering the least amount of obstruction to the passage of air through the larynx, affording ready exit to mucus, saliva, or vomited materials, and easy access to the phrenic nerve for compression. The finger is left free to palpate the facial artery at the margin of the jaw. This forward position of the jaw is instituted at the earliest moment that the relaxing muscles will permit, and it is maintained throughout the narcosis. If the jaw is allowed to slip back, the breathing instantly becomes stertorous and embarrassed. It is seldom that quiet, almost noiseless, breathing can not be maintained throughout a narcosis. The yielding of the jaw is a trustworthy indication of the approach of surgical narcosis. If the jaw is rightly managed the gag and the tongue forceps will very seldom be needed. When the forceps are used it is seldom necessary to lacerate the tongue or to nearly amputate it by pulling it constantly downward across the lower incisors. The administration of the anesthetic, whether ether or chloroform, should begin gradually. Have the patient count aloud after the anesthetizer, in a drawling monotone, with the dry mask held above the face for a moment, and then, while the anesthetic is being applied, drop by drop, to continue the counting slowly until the stage of unconsciousness. If the amount of anesthetic be increased very gradually and "crowding" avoided, there will seldom occur disagreeable symptoms, such as coughing, spasm of the glottis, struggling, etc. Surgical anesthesia is best indicated by a contracted, immobile pupil. The practice of touching the cornea with the finger to determine the presence or absence of surgical anesthesia is harmful and unnecessary.

There are persons in whom complete surgical anes-

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thesia can not be safely maintained, that is, as soon as the signs of complete anesthesia become manifest, danger signals appear with such positiveness that the administration must be temporarily discontinued. For this reason it will be impossible in some instances to secure complete muscular relaxation. Surgical narcosis having been attained, which should occur in from 7 to 12 minutes, it should be maintained with the least possible amount of the anesthetic. This is not often done. I am convinced that nearly all of the decidedly bad effects, both immediate and remote, attributed to anesthetics are due either to unnecessary overdosing; to too rapid administration; to faulty preparation of the patient, mental and physical; to bad selection of the anesthetic, or to its poor quality; to careless after-management; or to several or all of these factors combined. It is not always easy to determine when a patient is receiving just the right amount of anesthetic. So long as the pupil is contracted and immobile there is no question, but in the cases where this does not occur, other signs must, of course, be depended on. The so-called "secondary dilation" of the pupil may mean impending danger from too much, or awakening of the patient from too little anesthetic. Frank E. Simpson[49] of Chicago says: "The most valuable sign of beginning awakening of the patient is the rolling of the eyeball from side to side. This, in my experience, always happens just as the patient is passing the border line between deepest narcosis and its lesser degrees, and precedes by some moments other evidences of returning consciousness. This lateral rotation of the eyeballs is slow and hesitating in character and occurs at intervals of a few seconds. It is a signal to the anesthetizer that a few drops more of the anesthetic from time to time will prolong almost indefinitely the proper operating condition."

There are two ways of avoiding overdosage, which

49. American Medicine, vol. iii, p. 354.

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are too often neglected: 1, expedition in getting the patient on the table and ready for the surgeon after narcosis is complete; 2, as rapid operating as is consistent with thoroughness and safety. In fewer words, avoid giving the anesthetic a moment longer than necessary.

Dosage.—Anesthetists are not yet agreed on this point, some maintaining that the effect should be regulated by the dose, others that the dose should be regulated by the effect. The former say that definite dosage is as important and as easy of accomplishment as with other poisonous drugs. Elaborately constructed inhalers are used for the purpose of measuring the amount of anesthetic administered in a given time, that is, the percentage of anesthetic vapor in the inspired air is measured. The Krohne inhaler is a type of this class for chloroform. It gives 4 per cent. chloroform vapor, which is supposed to be comparatively safe, while a 5 per cent. vapor is very dangerous, and a 6 per cent. vapor fatal. The simple inhaler is the safest one. The dose should be regulated by the effect, the same as with other drugs. The average dose will not answer, because it will be too much for some and not enough for others, while the minimum will be insufficient for many. By watching the effect closely and intelligently the dose can be regulated to the best possible advantage. Exactness can not be reasonably expected.

Danger Signals.—There is no one signal that is an infallible early guide. The pupillary reflexes are the best single guide to impending danger. A rapidly dilating pupil means danger, and a fixed, dilated pupil means extreme danger. A contracted, immobile pupil usually indicates safe surgical anesthesia; a pupil oscillating between contraction and dilation, diminishing anesthesia. The pupil is sometimes modified by the nature of the operation, as by manipulation of extremely sensitive tissues, or by suddenly changing the patient's position. The color of the face, lips, ears, and nose should

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be constantly observed. An ashen hue of any of these parts should create apprehension. Blueness of the skin is generally due to asphyxiation, and is much less dangerous than abnormal paleness, which generally indicates gradual poisoning of the circulatory mechanism, including the center in the medulla. To emphasize these conditions, Wm. Mitchell Banks[50] speaks of the "blue" man and the "white" man. The latter is in great danger. A. P. Ohlmacher[51] maintains that in the condition of lowered vital resistance known as the lymphatic constitution there is a strong tendency to sudden death in anesthesia. The respiration and pulse should be watched in all cases with the greatest care, no matter what anesthetic is being administered. The followers of Syme, including the Hyderabad Commission, believe that in chloroform anesthesia the respiration should be watched, while the pulse may be neglected. The general belief in this country is that the circulatory system is first to show the danger. This difference of opinion serves to emphasize the fact that every possible danger signal should be carefully sought during the entire narcosis. This observation applies to all anesthetics. Ether, however, affects the respiration especially. The anesthetizer should be on his guard to prevent sudden increase in the amount of anesthetic inhaled and the overwhelming of the patient with it, which may occur from several deep inspirations due to manipulating sensitive or inflamed tissues, divulsing the sphincter ani, etc., or after holding the breath. Certain patients, especially chronic alcoholics, the nervous, and occasionally the very vigorous, are apt to resist the action of the anesthetic. This resistance, if due to either anesthetic alone, can usually be lessened or overcome by the use of both anesthetics together for a few moments. When ether produces undue irritation of the air passages, a little chloroform dropped on the mask will generally obviate the difficulty, and

50. THE JOURNAL Am. Med. Assn., Dec. 7, 1901, vol. xxxvi.
51. Philadelphia Med. Jour., March 10, 1900.

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when chloroform causes bad symptoms a little ether for a short time may afford relief. If a patient struggles during primary anesthesia, it is usually bad practice to force the anesthetic. In one whose arteries are unelastic, apoplexy is liable to occur under these circumstances, and syncope may occur from suddenly overcharging the blood with the anesthetic. It should be kept in mind that patients in the primary stage of anesthesia are apt to be in a state of imaginative intoxication, and the application of force will cause them to struggle. The proper way in most instances of undue excitement is to suspend the administration until the patient is calmed. The reflex rigidity occasioned by manipulation of sensitive tissues often demands temporary withdrawal of the anesthetic, whereas the temptation is to "crowd" it. Likewise, great vigilance should be exercised by the administrator when the surgeon is severing large nerve trunks.

Respiration during anesthesia should, as a rule, be easy and quiet. Snoring or stertor suggest either partial obstruction or too much anesthetic. Embarrassed respiration in the primary stage of anesthesia may be remedied by suspending administration for a few moments. In the later stages it may be due to mechanical obstruction, such as dropping back of the tongue or the epiglottis, collection of mucus in the pharynx or lower air passages, or to edema of the glottis. It should be remembered that heaving of the chest may mean only "spurious" breathing—that is, all the reflex phenomena of respiration may be in action, yet no air enter the trachea. It is astonishing how often the anesthetizer fails to grasp the real situation, until the patient has nearly or quite ceased any attempts at respiration; and when finally he has recognized the difficulty he not infrequently makes unnecessary maneuvers, wasting valuable time, before he accomplishes the desired result, which, perchance, may be only the lifting forward of the jaw or pulling forward the tongue. The jaw is easily lifted forward by placing the thumbs on the symphysis, the

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fingers on the posterior border of the angle of the jaw, and while slightly depressing the symphysis with the thumbs pulling forward with the fingers so as to bring the lower dental arch in front of the upper. When the epiglottis drops back it is necessary to introduce the finger into the mouth and lift it away from the glottis. If these maneuvers fail, artificial respiration by the Sylvester method should be instituted. If then no air enters the lungs, the trachea should be opened. If the heart becomes weak during the anesthesia, it is well to inject subcutaneously a cardiac stimulant, as nitroglycerin, digitalis, spartein, strychnin. If amyl nitrite be given, remember it is only the temporary vasomotor dilator action that is wanted. If pushed beyond this not easily determined limit it may cause cardiac paralysis. The head-down position, by determining more blood to the circulatory center, aids in strengthening a heart which has become gradually weak.

TREATMENT OF EMERGENCIES.

Methods of treating emergencies may be thus summarized:

1. Reflex excitation of respiration by external application—for example, cold or cautery to the epigastrium, ammonia vapor to the nostrils.

2. Reflex excitation of respiration by mechanical means—as rhythmic traction on the tongue (Laborde), or divulsion of the sphincter ani.

3. Artificial respiration. Tracheotomy (when other means fail).

4. Measures counteracting circulatory failure—like posture or rhythmic compression of the chest or abdomen.

5. Cardiac stimulants—as amyl nitrite, nitroglycerin, strychnin, atropin, spartein, aromatic spirits of ammonia.

6. Bleeding from a large vein to relieve the over-distended right heart (when other means fail).

In the majority of cases oxygen, either pure or at-

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mospheric, is the best resuscitant; but in some instances well-selected drugs are beneficial.

It should be kept in mind that in the first and second classes the nerves must be sufficiently alive to convey stimuli.

ANESTHETICS AND ARTIFICIAL LIGHTS.

On account of its explosive nature, ether must not be brought into close proximity to exposed artificial lights or the actual cautery. If used at night in the presence of gas or lamp light, the light should be placed as far above and away from the patient's face as possible.

When chloroform vapor comes in contact with gas or lamp flame, it is decomposed into Cl, HCl and CCl_4. Some or all of these gases are very irritating to the respiratory mucous membranes and often cause violent coughing on the part of persons in a room where chloroform is being used. Gerlinger[52] reports an operation lasting 3 hours under these circumstances, during which 2 physicians and 4 hospital sisters were seriously affected, one of the sisters dying two days later. D. H. Galloway, Chicago, suggests hanging a cloth saturated with aqua ammonia in the room to overcome this difficulty. The two gases combine chemically, forming ammonium chlorid.

POSTANESTHETIC MANAGEMENT.

Having brought the patient safely through the anesthesia, it is important to protect him against unnecessary postanesthetic complications, especially bronchitis, pneumonia, etc. All anesthetics predispose the patient to these and other troubles by lowering the vitality. The patient has been in a warm operating room, and after leaving it should be protected from drafts and cold air while being removed to bed. The bedroom and the bed should be warm, and they should be kept warm until perfect reaction has taken place. Aspira-

52. Arch. f. Exper. Path. u. Pharm., Bd. xlvii, Heft 5 and 6.

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tion pneumonia should be guarded against by seeing that the patient does not unnecessarily aspirate vomited material into the trachea. The system should be amply supplied with fluids, either by stomach, by rectum or subcutaneously (physiologic saline solution), to restore the equilibrium of the functions and favor elimination. The patient should be nourished as well as circumstances permit. Many patients have been practically starved to death by receiving insufficient food and liquid to maintain physiologic resistance. All these considerations count in the final summing up of results.

VOMITING DURING AND AFTER ANESTHESIA.

Serious or persistent vomiting, either during or after anesthesia, can nearly always be prevented by right management of the patient and of the anesthesia. In the first place, the patient must be properly prepared for the administration, and an anesthetic selected which is suitable for the particular case in hand. Vomiting during the anesthesia may be due in some instances to letting the patient come partially out of the anesthesia, or to "crowding" too much. Changing the posture of the patient, especially in incomplete narcosis, may also cause it. In a large percentage of cases, retching, vomiting, or hiccough can be controlled by compressing the phrenic nerve, the motor nerve of the diaphragm, as suggested by B. Joos of Winterthur, Switzerland. Firm, gentle pressure is made by the pulp of the thumb or finger directly backward just above the clavicle in the space between the two heads of the sterno-cleido-mastoid muscle, the patient's head having been turned to the right. At this point the phrenic nerve is in relation with the anterior surface of the scalenus anticus muscle and can be compressed against it when the muscle is put on the stretch by turning the head to the opposite side. On the left side the nerve passes more nearly over the center of the muscle than on the right. In 225 consecutive cases reported by L. H. Prince this method failed but 12 times. In order to be successful in the

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use of this measure, pressure should be commenced at the first sign of retching or hiccough, and should be continued for a few moments after cessation of the phenomena, to prevent their return.

Postanesthetic vomiting can be reduced almost to insignificance, if the patient is properly prepared for the anesthesia; if the anesthetic be carefully selected and skilfully administered; if the patient be transferred from the operating room to bed without much jarring, and kept perfectly quiet and free from disturbance in bed; and, finally, by freeing the stomach of accumulated mucus or bile. Formerly it was my custom to give the patient from a half pint to a pint of hot water as soon as consciousness had returned sufficiently to permit of swallowing. This either washes the contents of the stomach into the duodenum, or emesis occurs, either event doing good. During the past five years I have practiced gastric lavage, as suggested by I. P. Gunby of Sherman, Texas.[53] Physiologic saline solution may be used, and from one to two quarts is usually sufficient. A medium-sized or small soft rubber stomach tube is introduced, through the nose, as soon as administration of the anesthetic is suspended, and the stomach washed while the dressing is being applied. During the procedure the patient's body should be sufficiently inclined head downward to prevent fluid from entering the trachea. This procedure aids materially in reducing vomiting to insignificance.

Another method for the prevention or control of postanesthetic nausea, introduced by Mackinrodt, is the inhalation of vinegar. It is supposed to be equally efficacious after ether or chloroform. After trying it in several hundreds of cases, I have concluded that this method is of little value.

DEDUCTIONS.

1. It is not justifiable to employ any one anesthetic

53. Medical News, Jan. 21, 1899.

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exclusively. The safest anesthesia depends on: 1, the choice of the anesthetic best adapted to the case in hand; 2, the best technic of preparation, administration and general management; and, 3, a skilful anesthetizer.

2. The recent advance in our knowledge of local and neuroregional analgesia has materially narrowed the field of general anesthesia, but the local method can not supercede the latter.

3. Cases for anesthesia should be divided into three groups: 1, cases in which the indications for local anesthesia are absolute; 2, cases in which the indications for general anesthesia are absolute; and 3, doubtful cases. If in doubt, use the general anesthetic.

4. The mere fact that an operation can be performed under local anesthesia is not sufficient justification for its employment. As a rule, better work can be done under general narcosis, and, especially in septic cases, postoperative complications are less likely to occur after a skilfully conducted general anesthesia than after local.

5. Both ether and chloroform exert a destructive effect on the erythrocytes and reduce the amount of hemoglobin (chloroform having the greater destructive action), hence, in anemic patients at least, the blood should be examined before administering an anesthetic. When the percentage of hemoglobin is below 40 an anesthetic should not be given when it can be avoided. Even with a hemoglobin percentage of 50 the danger is great.

6. Chloroform tends to cause fatty degeneration of the heart, liver and kidneys, while ether has very little effect in this direction. On the kidneys the effect of ether properly administered is usually transient; that of chloroform is likely to be more serious and prolonged.

7. Ether is a respiratory depressant, and usually exerts its bad effects primarily on the respiratory system. Chloroform is a circulatory depressant, and usually exerts its bad effects primarily on the circulatory system.

8. Nitrous oxid is a true anesthetic, and can be em-

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ployed for prolonged operations (where complete muscular relaxation is not essential) when administered with certain proportions of oxygen, either pure or atmospheric. Its use is satisfactory only in skilled hands.

9. Ethyl bromid and ethyl chlorid are convenient for primary anesthesia and for short operations. They are probably less dangerous than chloroform. Both are circulatory and respiratory depressants.

10. Chloroform can not be made as safe as ether by admixture with other drugs, although the danger in its administration may be somewhat reduced by this means.

11. As a rule, strychnin or other heart tonic is indicated in the debilitated or preliminary to chloroformization, and morphin and atropin preliminary to etherization. Oxygen and posture are the best resuscitants.

12. Ether produces less circulatory depression than chloroform. It causes dilation of the arterioles and increased capillary circulation, thereby insuring a good blood supply to the circulatory and respiratory centers and to the heart muscle; consequently these systems are in less immediate danger than with chloroform.

13. On account of the reduction of body heat by anesthetics, they should be administered in a warm room; and the patient should be protected from loss of heat by proper covering of the body, by keeping it dry so far as practicable, and by application of artificial heat when necessary. The temperature of the operating room should not be above 85 F. In changing the patient from operating room to bed, beware of cold halls or drafts.

14. Compression of the phrenic nerve will, if properly managed, usually control retching and kindred symptoms occurring during narcosis.

15. Postanesthetic nausea is best prevented by preparation and after-treatment which favor physiologic tonus, with especial reference to the emunctories, and by gastric lavage at the termination of anesthesia. Troublesome vomiting is in most instances quite un-

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necessary, no matter which anesthetic has been given. Chloroform is likely to cause more persistent nausea and vomiting than ether.

16. Patients should be well fed with easily digested and non-bulky food to within a few hours preceding anesthetization, and should be allowed water to within 2 or 3 hours of it. This plan reduces shock, favors elimination of the anesthetic and other waste products without undue irritation of the emunctory organs, and the patient will not suffer much from thirst and nausea. For the same reasons water should be given as liberally as practicable after anesthesia.

17. The danger from hemorrhage is no greater with ether than with chloroform, if as great, since the bleeding which occurs from the effects of ether is primary and is more certainly provided against; while the circulatory depression and vasomotor constriction due to chloroform to a great extent prevent primary bleeding and lead indirectly to later hemorrhage.

18. The safety margin between sufficient chloroform for anesthesia and the lethal dose is much narrower than it is with ether.

19. Anesthetic mixtures are in general less safe than the "straight goods." It is impossible to know the relative proportions of the different components of a mixture that the patient actually inhales; and when accidents occur the anesthetizer is hampered in his treatment by not always knowing which constituent is causing the trouble.

20. Ether-oxygen narcosis is safer than ether alone, by the "closed" method, but the oxygen gas is superfluous in most cases where ether is properly administered.

21. The ethyl bromid-ether method is a time saver, but is not safe. Ethyl chlorid-ether is probably still less safe.

22. Morphin-ether-chloroform anesthesia is of positive advantage in operations about the face, where it is difficult to maintain surgical narcosis by the ordinary means.

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Souchon's special inhaler is a valuable adjunct in these circumstances.

23. As a rule successions of anesthetics should be avoided, with the exception of nitrous oxid-ether.

24. Ether given alone is especially dangerous in the presence of arteriosclerosis, and chloroform especially so in anemia and where there are degenerative changes in the vital organs.

25. Partial or "talking" anesthesia is best in some cases, but should be avoided in prolonged operations unless taken quietly and with apparent abolishment of pain sense.

26. Primary ether narcosis stands next to nitrous oxid for short operations.

27. Hypnotic anesthesia should be employed only exceptionally, if at all.

28. In a patient liable to recurrent insanity, anesthesia is dangerous, but not so in one already insane.

29. Paralysis following anesthesia is almost always a pressure paralysis and is preventable.

30. In myocardial disease all anesthetics are especially dangerous, while in purely valvular disease they usually create but little disturbance. Ether is the anesthetic of choice, and is safer for many major operations in these cases than local anesthesia. Asphyxiation should be especially avoided in administering an anesthetic in the presence of heart disease. The use of chloroform is entirely out of question in myocardial disease.

31. In the plethoric and the obese, especial care must be exercised in the selection and administration of anesthetics, the chief danger encountered being from respiratory disturbance (often due to turgescence and consequent swelling of the boundary parts of the upper air passages).

32. Ether is the best anesthetic in obstetric practice. Chloroform is more dangerous to both mother and child.

33. Rectal etherization is feasible, but too dangerous to be employed in a routine way in any class of cases.

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34. Any anesthetic, but especially ether, should be given with the greatest caution in the presence of special susceptibility to acute bronchial affections. Great care should also be exercised in the presence of asthma, and chloroform is in some cases preferable to ether.

35. Patients with peritonitis require a dangerous degree of anesthesia to produce relaxation of the abdomen. The anesthetizer should be extremely careful about "crowding" the anesthetic to overcome the rigidity brought about by the manipulation of sensitive or inflamed tissues, since handling such tissues often causes a dangerous degree of shock.

36. The best type of inhaler, for both chloroform and ether, is one made on the principle of the Esmarch chloroform mask.

37. The tongue forceps and the gag are seldom required, and the latter often endangers life, as ordinarily used. The right management of the jaw during narcosis will nearly always render these instruments superfluous.

38. The anesthetizer should gain the confidence of the patient as to his carefulness and ability, so that the mind may be at rest on these points. Patients who greatly fear anesthesia are the ones liable to cause the anesthetizer the most trouble.

39. The patient should be kept as free as possible from noise and other disturbances during the induction of anesthesia.

40. "Crowding" an anesthetic is usually not justifiable, as it adds materially to the danger. The necessity for "crowding" is the chief objection to the use of the nitrous oxid-ether method as ordinarily carried out.

41. No time should be lost in getting the patient in the hands of the surgeon after narcosis is complete; and the surgeon should operate as rapidly as possible consistent with good work.

42. In administering an anesthetic the dose should be regulated by the effect. The elaborately constructed

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pseudo-scientific apparatus for accurately measuring the dose is dangerous, cumbrous and expensive.

43. When chloroform is used, administer it slowly, especially in the early stages of anesthesia. The amount of anesthetic needed for the average subject varies with climatic conditions.

44. The pupillary reflexes constitute the best guide to the presence or absence of surgical anesthesia, and the best danger signal. Touching the cornea with the finger to determine the presence or absence of surgical anesthesia is unwarranted. The anesthetizer should watch carefully the pupils, pulse, respiration, and the color and condition of the skin, depending on no single symptom as a danger signal. The patient should be carefully watched from the beginning of the anesthesia until fully restored to consciousness.

45. When anesthetics are properly administered the patient seldom struggles. Noisy respiration during anesthesia should be the exception, as it generally means faulty management.

46. The minimum amount of anesthetic should be given which is consistent with the production and maintenance of the desired degree of anesthesia.

47. The weight of evidence is overwhelmingly in favor of ether rather than chloroform. There are very few contraindications to ether when it is properly managed.

48. Statistics do not sufficiently represent the dangers encountered, as the hair-breadth escapes far outnumber the deaths.

49. The skilful anesthetizer is never at a loss to know what to do in emergencies—and he does the necessary thing instantly. Most of the deaths occur in the hands of the relatively unskilled.

50. The greatest danger from chloroform is during the second stage of narcosis. Profound chloroform narcosis should not be induced within five minutes, nor should it often require more than ten minutes to produce it.

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51. Chloroform is nearly or quite as dangerous in the vigorous as in the debilitated, because the vigorous circulation takes it up and distributes it rapidly. Often it is the concentration of chloroform in the system, rather than the amount, which kills.

52. In the treatment of anesthetic asphyxia, tracheotomy should be resorted to when other means fail.

53. In anemia of the medulla the patient should be placed in the head-down position. In sudden paralytic dilation of the right heart, as after several deep inhalations of chloroform, the heart should be rhythmically compressed by squeezing the chest; or the patient placed temporarily in the feet-down posture to empty the heart, artificial respiration being constantly maintained.

54. The safe anesthetic will probably never be found, as the production of unconsciousness has an element of danger associated with it. Nitrous oxid-oxygen anesthesia is the safest anesthesia known.

55. It is more the method employed and skill displayed in administering anesthetics than the particular anesthetic used that in most cases lead to favorable termination and rapid recovery from an operative procedure.

56. The surgeon is frequently more concerned about the anesthetizer's work than about his own, as in over half the cases the anesthetic is more dangerous than the operation. The surgeon can not do his best operating while devoting half his attention to the anesthetic.

57. When possible, anesthetics should be administered by those especially skilled in their use. The specialist in anesthesia is a necessity of the times, and in order to become a first-class anesthetist special aptitude is required.

58. The subject of surgical anesthesia should be taught as a special branch in medical colleges, and each senior student should have practical experience along this line, under the supervision of a skilled anesthetist.

59. If all physicians and surgeons could be made to

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realize the fact that chloroform is vastly more dangerous than ether, then chloroform would be discarded as a routine anesthetic and used only in exceptional cases.

NOTE.—At the meeting of the American Surgical Association, held in Washington, May 12-14, 1903, John C. Munro, Boston, reported a series of 500 surgical patients showing albumin and casts in the urine, without evidences of renal degeneration before anesthetization. Nearly all of these patients were anesthetized with ether, and in none of them was any noticeable renal damage inflicted. Most of these patients were of the poorer classes and entered the hospital poorly nourished and debilitated.

DISCUSSION.

DR. JAMES E. MOORE, Minneapolis—I dissent from the last statement the gentleman made. I have been doing surgery for the past thirty years, and have done a lot of it during the past twenty years. I have used chloroform in 95 per cent. of all my operations, and I have never had a death, either at the time or subsequently, due to the anesthetic. The author says that when a patient dies from ether anesthesia it is usually due to faulty administration. That remark, gentlemen, applies eminently to chloroform. His third conclusion is worth discussion, if he had made no other remark during his whole paper. He says a competent anesthetizer is necessary. With a competent anesthetizer I have no fear of chloroform, save in cases where its use is contraindicated, and the longer I use it the more convinced I become of the truth of this principle. It is not the anesthetic that is dangerous so much as the unskilled anesthetizer.

DR. A. J. OCHSNER, Chicago—The statement made by Dr. Moore concerning the anesthetist who understands his business thoroughly is absolutely correct, but we must remember that more than one-half, and possibly more than three-fourths, of all the anesthetics are administered by anesthetists with very little experience, consequently, with the conditions as they exist, I believe that the last conclusion of the author will still stand. In my own practice I use chloroform to anesthetize the patient regularly and change to ether before the operation is begun, unless there is a distinct contraindication, and I do it because I have a competent anesthetist. I would not do so unless I had. So, taking the conditions as they should be, I believe that Dr. Moore's point would be perfectly right, but taking the conditions as they exist, I believe that the author's conclusion is absolutely correct. There is always a feeling of confidence in the operator, if his anesthetist is not experienced in giving ether, because the more he gives the better it is for the patient, while, if the same

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anesthetist should give too much chloroform it would be very bad for the patient. I would say that if either of these anesthetics give trouble to the patient, then that anesthetic should not be used again during the same operation. If chloroform be given and the patient shows any bad symptoms, the chloroform should be abandoned throughout the operation, because the second or third time that trouble comes it may be fatal. In the administration of chloroform one point to be borne in mind which very frequently is overlooked, is that when trouble comes it is important to get rid of as much of the chloroform as possible. In making artificial respiration for the purpose of resting the patient, as a rule, the first thing done is to lift the arms and fill the lungs, presumably with air, but as a matter of fact with the chloroform, which is in the upper part of the lungs, and therefore, instead of giving the patient air you give him a very large dose of chloroform on top of what he already has. Therefore, the first thing to do is to make a number of very rapid and complete compressions of the chest in order to force out as much of the chloroform as possible. Aside from artificial breathing, I believe there is absolutely no use in all the methods which have been recommended for the purpose of reviving patients who have gotten into a dangerous condition during the administration of an anesthetic. There are but very few minutes to do anything for the patient if there is real danger. The practice Dr. Mellish makes of preparing the patient is very good. By his taking a big dose of castor oil to get rid of the fecal matter he is placed in a much better condition to stand the anesthetic. Of course, if his kidneys are bad, or if he has a bad heart, these conditions should be looked after. The element of confidence on the part of the patient is of the very greatest importance. If you have a person giving the anesthetic in whom the patient has confidence that patient is not likely to get into trouble. If the patient vomits after the operation, gastric lavage will give immediate relief in most cases.

Dr. M. B. Tinker, Baltimore—Local anesthesia I feel should be so much more extensively used than is now done. Many surgeons do not appreciate how much can be done under local anesthesia. As an example, hernia operations can be done under cocain and with so little discomfort to the patient that they say in many instances that the pain is less than attempts made to reduce the hernia by taxis. I would not advocate local anesthesia in all cases by any means, but I am convinced that it does save a certain number of deaths from ether pneumonia, lung embolism, heart failure and other causes which I do not believe can be avoided if general anesthesia is employed. Several factors essential to success in the use of a local anesthetic: In the first place the

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patient should understand the advantages of operation under local anesthesia, and want it done in this manner. If he does not want the operation done in this manner he will object to the slightest pain and you will not be successful. Another point of great importance is the necessity for taking plenty of time; you can rush local anesthesia. You have to take care to infiltrate tissues well and take time for dissection. If you do not you will cause your patient much pain and he will complain so bitterly that you can not complete the operation. A good sized preliminary dose of morphin is also of great importance, say 1-6 of a grain one hour before the operation, another 1-6 at the beginning of the operation and still another 1-6 during the operation. A good moral anesthetist at the head of the table will be of great advantage in distracting the patient's attention from the slight pains.

DR. WILLIAM J. MAYO, Rochester, Minn.—We have for years preferred ether to chloroform, even though there may be just as many deaths from ether as from chloroform. When a fatal result does occur, the patient has a much better chance to bid good-bye to his friends than if he died from chloroform anesthesia. Dr. Ochsner brought out one very excellent point, that the first thing to do in trouble from chloroform anesthesia is to force all of the chloroform out of the lungs by compressing the lungs before forcing the patient to take an inspiration. The Souchon anesthetizer is a very valuable apparatus for operations on the throat and mouth.

There is a large tendency in this country to settle things in the laboratory. This can not be done. Now, take the question of hemoglobin, and the influence which it exerts on anesthesia; the amount of hemoglobin present is not usually so important a fact as is the cause of a loss of hemoglobin. I have often operated when the hemoglobin was as low as 25 per cent., due to hemorrhage, and I have never seen an accident following such an operation. But if you do an operation on a case in which from some malignant cause the hemoglobin is reduced to 40 per cent. or 50 per cent., and the oxygen-carrying power of the patient is decreased, you stand a chance to lose the case because with cachexia the blood is poor in oxygen-carrying power. We are exceedingly afraid of low hemoglobin in cancerous disease, but I would not hesitate to perform an operation with the hemoglobin as low as 25 per cent., provided the disease is due to blood loss resulting in anemia, and provided I can reach the cause of the loss of hemoglobin.

DR. JOHN E. SUMMERS, JR., Omaha—I want to call attention to the post-operative effects of anesthetics on the temperature curve. For some time I have been noticing that after prolonged operations under ether we would occasionally get

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a temperature curve. This used to be called "reaction," but now I have become convinced that it is due to the anesthetic. I have gotten so that I think I can recognize it, and am not alarmed.

Anybody who has lost a case on the table never forgets the anesthetic. I have had the misfortune to lose one case on the table from chloroform, and it does not make me feel any better to know that every surgeon in my vicinity has had the same experience. Death comes so suddenly that it does not give you an opportunity to protect yourself or your patient. Dr. Mayo has expressed it very nicely by saying that it does not even give the patient an opportunity to say good-bye to his physician or his friends. Recently a little child was brought into the hospital with a compound fracture of the leg. He was given chloroform and the fracture reduced. Just as he was coming out of the anesthetic he vomited and aspirated some potato into his trachea. I opened the trachea immediately, but the child died from asphyxiation. I think it is always better in emergency work, especially among children, to wash out the stomach prior to the administration of the anesthetic, and in our hospital where much emergency work is done, I have made this a standing order because we can not know whether the stomach is empty or full.

In the Johns Hopkins Hospital, I notice by their Bulletin, that Cushing has found by experiments with the tonometer that chloroform always reduces arterial pressure more than does ether. I think there is no doubt that we are more liable to have accidents happen if we use chloroform than if we administer ether.

Dr. E. J. Mellish, El Paso, Texas—Dr. Ochsner spoke about using chloroform in all cases when he has a competent anesthetizer. It can be used more safely with a competent anesthetizer, but I have found from experience that no matter how chloroform is used it is more dangerous than ether. Dr. Moore's favorable experience with chloroform is doubtless due to skilful management of the anesthesias. Within a period of eight years I saw four deaths on the table from anesthetics, three from chloroform and one from ether. The patient who died from ether was extremely apprehensive before the anesthesia—lacked the necessary confidence in the anesthetizer. When this confidence is absent the danger is greatly increased. I have had at my disposal the records of 6,000 anesthesias at a Chicago hospital. The first three thousand anesthetics were given under the supervision of skilled anesthetizers. The last three thousand were given by those much less skilled in the administration of anesthetics. There were three deaths in this series, all occurring in the second three thousand cases. When chloroform is used, dangerous symptoms are likely to develop much more rapidly than

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after ether administration, and in the latter condition you have a much better chance to resuscitate your patient.

Another thing is, that chloroform, being heavy, is eliminated very slowly, and it has been detected in the sputa two or three days after the anesthesia. This means that the patient is continuously more or less poisoned during this time. Ether is eliminated much more rapidly.

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DANGERS ATTENDANT ON ATTEMPTS AT GAINING THE INTERVAL IN OPERATIONS FOR APPENDICITIS.

RICHARD H. GIBBONS, M.D.
SCRANTON.

It is strange that medical men in general and anatomists and physiologists in particular claim that the appendix vermiformis has no function, that it is a useless appendage, playing the part of catching any old thing, or furnishing the surgeon opportunity to rake in ill-gotten gain. Ridiculous as it is to compare inanimate things to parts of the human body, it may be well to do so here, in order to state that at such a right-angled junction as is formed by the ileocecal connection, an oil cup would be furnished in mechanics, while in hydraulics, as in a sewerage system, for instance, a manhole would be placed. This appendage apparently has secretory functions by which, it is fair to assume, the natural tendency to pastiness of the residue of digestion, after it comes to the cecum, is so modified that it is rendered less adhesive; the cecum being the receptacle for the effete fecal mass needs, it would appear, lubricating material, and this assumption indicates the necessity therefor, in order that the fecal current and the propulsion of the mass may not become interrupted. Whether this assumption is based on incorrect reasoning, the physiologic chemist ought to be able to demonstrate.

A normally situated appendix free from disease means to its possessor, other things being equally normal, that

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he shall be freer than others from the one great danger attendant on life from the cradle to the grave—constipation. Understand that no inference is to be deduced from this statement that constipation is the cause of appendicitis; on the contrary, appendicitis or appendiceal irritation, from which one may suffer a great part of his lifetime before sufficiently extensive involvement takes place to make up the condition known as the "attack," is always productive of constipation; mark the distinction as well as the difference. Constipation seldom, if ever, produces appendicitis. Diarrhea may occasionally do so; these conditions usually are but symptoms of the disease; that they are relieved by non-surgical means is not evidence that they were the cause of, nor that it is cured by such relief.

This brings us to the consideration of the many ailments referred to the gastrointestinal tract during infancy and childhood which are often misinterpreted as "gastric difficulties," "cholera infantum," "cholera morbus," "colic," "gastrointestinal," "intestinal" and "nervous dyspepsia," "liver ailments," "constipation," or even "diarrhea"—for a diseased appendix quite as often causes diarrhea as constipation, and sometimes we note these conditions alternating in given cases. Such "ailments," "difficulties" and "disturbances" are nearly if not always, due to a diseased appendix, the disease condition, located in its mucous membrane, having been produced by some infection, the result of impure food-product, or by the exanthemata, influenza; or, catarrhal inflammation due to cold is as likely to affect the mucous membrane of the appendix as mucous membranes elsewhere, even to the extent of slight superficial ulceration thereof, each attack passing through the various stages on to the process of cicatrization, the appendix itself not showing any marked pathologic change at the time of these repeated ulcerative attacks. Eventually the stenosed or strictured conditions following the inflammatory changes show up as cicatricial contractions and these

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form more or less perfectly retentive diaphragms which interfere accordingly with the complete emptying of the appendix of its secretions, or its attempts at ridding itself of foreign particles that may be accidentally forced into its lumen; an appendix thus crippled during infancy or childhood, while a menace to perfect health and likewise to life, may not until years after the initial disturbance cause highly dangerous or fatal effects. During these years the symptoms may be of the character known as "digestive disturbances," and the patient may have taken numerous forms of quack nostrums.

In making our diagnoses for appendicitis we should have to contend with but three forms of the disease: the pre-inflammatory, the inflammatory, and the post-inflammatory. Further division and subdivision serve but to confuse and bring about an obscure or doubtful diagnosis which in turn serves to bring about delay until the opportune moment is passed. In our examinations let us not look for symptoms alone at the great risk of misinterpreting them; rather let us look for signs, one sign in particular, that of tenderness.

This sign was pointed out to us years ago by Dr. Charles McBurney of New York City, and it is almost infallible in determining the condition of advancing inflammation of the appendix. As you know, its presence is made manifest by pressure being applied at the point that is known to be the normal site of the base of the appendix when it is involved by lymphangitis. McBurney described it as a point of exquisite tenderness, and his friend, Dr. Lewis A. Stimson, also of New York, named it "McBurney's point." A number of years ago I evolved a process of reasoning from my then somewhat limited knowledge of this subject and accordingly wrote an article which was published in the *New York Medical Journal,* April 18, 1891, page 452. At that time I entertained ideas that somewhat deprecated the value of this sign. Greater experience, however, has taught me

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to regard it most highly. I felt somewhat diffident of having published this article until about a year ago, when I read the statements regarding this point from the pen of the distinguished surgeon, Sir Frederick Treves. In his article he attempts, without success, to belittle the McBurney point as a sign of appendicitis by stating that he found that the location of the appendix in his postmortem work did not correspond with the "point" as noted in the living subject.

The refinement of the diagnostic sign of McBurney, palpation of the appendix, as given to us by Dr. Geo. M. Edebohls of New York, is the open sesame to the dismal cavern of appendicitis, for by this key, that of palpation of the appendix itself, we can trace its entire outline, and also detect the tenderness caused by disease situated within its walls and this during the pre-inflammatory stage. Hence its exceeding great importance, for on recognition of the relative value of these tests of McBurney and Edebohls and their application and prompt action as a result of the knowledge gained thereby, will depend the relative danger of early as compared with late operation.

The symptoms of acute appendicitis are of so definite a character that "he who runs may read" and the physician listening to the history of one suffering from an "attack" ought to be able to make a diagnosis by telephone and that even at long distance. Had one in his enthusiasm during the discussion of this subject at our last meeting made an appeal for a certain great leader of fashion, then the uncrowned King, to set a pace for the world to follow by having his diseased appendix removed, such disease condition having been interpreted from the daily press reports of his "stomach troubles," "intestinal difficulties," "influenza," and last, but by no means least, "lumbago attacks," how such a one would have been laughed at; and yet any experienced American physician or surgeon would have been warranted in interpreting these reports of the case, even at that time

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as meaning nothing else but appendicitis, thus making a diagnosis even by cable. The primary danger in connection with appendicitis is that the pre-inflammatory stage of the disease is not detected; this being due to the old time nonsensical ideas, among which that of a tumor of perityphlitic origin is uppermost, having been too strongly entrenched in the minds of many medical men. What a multitude of woes, miseries and sufferings could be swept away were we but to recognize in the infant or child its mildly diseased appendix, which in time, if left to the uncertainty of medical treatment, plus dietary juggling, must come to the inevitable state of diffuse inflammation, when still greater danger becomes attached to the situation, and this even though we operate at the very earliest hour of this stage of "attack." If we operate late in the attack, let us not forget that the operation may be followed by hernia, "to plague the patient and vex the surgeon," as Joseph D. Bryant has so aptly said.

The greatest danger of all, however, in connection with the diseased appendix is that of the "wait and watch" method of treatment, consisting of no matter what kind one may suggest, from the most heroic to that of the complete "let alone plan," instead of surgical intervention, until hour after hour has flitted away in the vain and forlorn hope that lost opportunity may return, until we find ourselves facing a problem, the outcome of which is most dubious regardless how well calculated may be its attempted solution. No amount of medical treatment or dietary adjustment can ever make amends for the delay that leads us into such a predicament. Every hour so lost regardless of what one's fancy may choose for him in his attempt at regaining this lost opportunity, the more surely adds its own danger, until danger after danger beset the path chosen so recklessly, as he casts aside the opportune moment for surgical treatment of which, if he take advantage, he will be saved embarrassment, to say the least. Another and very grave danger

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attendant on attempt at gaining what may seem to be the golden opportunity for surgical interference, or operation during "interim," is that the patient finding that he has recovered from his "attack" believes, and is encouraged by his medical attendant in thus believing, that he may have been "cured," so he flatly refuses to have an operation at this time, favorable and all, though it may seem to him. A number of such cases must have come under the observation of every medical man of considerable experience with patients afflicted with the disease. I have had quite a number; many of them are still miserable; some have died from other attacks, no operation having been performed, while a few have not been re-attacked; their time is yet to come. So that, after all due consideration has been given to the dangers attendant on attempt at gaining the "interim" in the operation for appendicitis, it would seem apropos to here cry "physics to the dogs," and that *immediate* surgical intervention should be the shibboleth of every physician and surgeon! To play on the immortal bard's great creation, the Soliloquy of Hamlet, why should not the sufferer from a diseased appendix say: "Doctor, why not rather *bare* the ills I now have than wait for others that you know not of?"

Treves says what is so well known even here in America, that there will die but about five per cent. of those first attacked by appendicitis! What man among us would be satisfied with a loss by death of five, two, one, or even a still smaller percentage? He also makes the statement that out of one thousand operations for appendicitis, during "interim," he has had but two deaths; so far, so good. The mortality need not be as great as one-hundredth of 1 per cent. if immediate operative measures be resorted to, on recognition of the disease during the pre-inflammatory stage. Why should Treves have had a death at all under such favorable conditions as surrounded his thousand cases? But has he told us how many people died during the

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process of treatment under which they must have gone, and that at the hands of many doctors, most likely, in order that each one of this apparently great number should get to the goal of his, Treves', ambition—the day of "interim"? If there were not accompanying deaths attendant on this doctoring, great was the feat, and we should know of what it consisted. Will any one here, even our friends Ochsner and Mayo, make any such heroic attempts as trying to get together one thousand cases for interval operation in appendicitis, without death attending at least 2 or 3 or even 5 per cent. of the number, and this even during the "first attack"? Ochsner should make himself more clearly understood here in New Orleans than he appears to have done elsewhere. A short time ago I listened to a report of the meeting held in Saratoga. The reporter took great umbrage when, in discussing his so-called "impressions" of the meeting, I made the statement that Ochsner did not pretend to more than attempt to get his patients in better condition for operation, which he performed as soon as it became satisfactory to him. The gentleman and others, his friends, took issue with me, all claiming that Ochsner "cured," note the word "cured," those cases by treatment, operations not being resorted to but occasionally; in fact, they stated that all of the successful cases reported in his discussion of Deaver's, La Place's and Parker Syms' papers at the Section's last meeting were not operated on at all, but were "cured" by his (?), Ochsner's, method of treatment.

In conclusion permit me to say, Mr. Chairman, that here in the South, and elsewhere, New York, Boston and vicinities, physicians in general are progressive and quite up to date in the management of appendicitis, while it is sad to note that in Pennsylvania, even though it be my own state, physicians, not always of the highest standing, however, point the finger of scorn and rail at passing brothers who stick to the surgical maxim, "Operate, and operate early!" So when Deaver says he has

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different cases from those seen in Chicago it is the truth, for perhaps in no other place on earth can the sodden, painful, phlegmonous mass typified so graphically in Joseph Price's "Green Groin" be as plentifully seen as in the City of Brotherly Love, and this in spite of Deaver's teaching, the following of which would but revert directly to the contrary of all of this.

DISCUSSION.

DR. H. D. NILES, Salt Lake City—So long as the large mortality from appendicitis comes from waiting for an opportune time to operate, so long as the small mortality comes from operating when we have the infection within the abdomen, so soon as the diagnosis is made, just so long, it seems to me, that we should operate immediately when we make the diagnosis. If we wait, we are waiting for the development of conditions that no man will now claim he can recognize. I do not mean by that that you can not tell the pulse or the temperature, or that you can not mention other symptoms, but no one can tell how dangerous it may be not to operate or how dangerous it may be to operate. No matter how small within the peritoneal wall, there may be that spurious and dangerous infection from the peritoneal cavity. With these uncertainties and with the expectation of occasionally choosing the wrong time, to me it seems best to operate when I know I have the infection, because I am not certain how long I can safely leave it.

DR. JAMES B. BULLITT, Louisville—One word in regard to the conception of the author's paper. My impression was that the question was whether or not Dr. Ochsner cures his cases with operation or without operation, and, therefore, I yield the floor to Dr. Ochsner.

DR. A. J. OCHSNER, Chicago—Evidently I have had the misfortune of being misunderstood. Since the Saratoga meeting of this Association I have stated my ideas on this particular point with the greatest possible care in the form of conclusions, which have appeared in the *Medical News* so that anyone who may be interested will have an opportunity in the future to see exactly what my position is regarding this subject. The same thing has been done in a number of publications, but I have in this one considered every point that has come out in any and all of these discussions. These conclusions were formulated as follows:

1. The mortality in appendicitis results from the extension of infection from the appendix to the peritoneum or from metastatic infection from the same source.

2. This extension can be prevented by removing the ap-

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pendix while the infectious material is still confined to this organ.

3. The distribution or extension of the infection is accomplished by the peristaltic action of the small intestines.

4. It is also accomplished by operation after the infectious material has extended beyond the appendix and before it has become circumscribed.

5. Peristalsis of the small intestine can be inhibited by prohibiting the use of every form of nourishment and cathartics by mouth and by employing gastric lavage in order to remove any substances of food or mucus from the stomach.

6. The patient can safely be nourished during the necessary period of time by means of nutrient enemata. Large enemata should never be given, for they may cause the rupture of an abscess into the peritoneal cavity.

7. In case neither food nor cathartics are given from the beginning of the attack of acute appendicitis and gastric lavage is employed, the mortality is reduced to an extremely low percentage.

8. In cases which have received some form of food and cathartics during the early portion of the attack and are consequently suffering from a beginning diffuse peritonitis when they come under treatment, the mortality will still be less than 4 per cent., if peristalsis is inhibited by the use of gastric lavage and the absolute prohibition of all forms of nourishment and cathartics by mouth.

9. In this manner very dangerous cases of acute appendicitis may be changed into relatively harmless cases of chronic appendicitis.

10. In my personal experience no case of acute appendicitis has died in which absolutely no food of any kind and no cathartics were given by mouth from the beginning of the attack.

11. The mortality following operations for chronic appendicitis is exceedingly low.

12. Were peristalsis inhibited in every case of acute appendicitis by the methods described above, absolute prohibition of food and cathartics by mouth and use of gastric lavage, appendectomy during any portion of the attack could be accomplished with much greater ease to the operator and correspondingly greater safety to the patient.

I would make the following suggestions for the treatment of appendicitis with a view of reducing the mortality:

1. Patients suffering from chronic recurrent appendicitis should be operated on during the interval.

2. Patients suffering from acute appendicitis should be operated on as soon as the diagnosis is made, provided they come under treatment while the infectious material is still confined to the appendix, if a competent surgeon is available.

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3. Aside from insuring a low mortality this will prevent all serious complications.

4. In all cases of acute appendicitis without regard to the treatment contemplated the administration of food and cathartics by mouth should be absolutely prohibited and large enemata should never be given.

5. In case of nausea or vomiting or gaseous distention of the abdomen, gastric lavage should be employed.

6. In cases coming under treatment after the infection has extended beyond the tissues of the appendix, especially in the presence of beginning diffuse peritonitis, conclusions four and five should always be employed until the patient's condition makes operative interference safe.

7. In case no operation is performed neither nourishment nor cathartics should be given by mouth until the patient has been free from pain and otherwise normal for at least four days.

8. During the beginning of this treatment not even water should be given by mouth, the thirst being quenched by rinsing the mouth with cold water and by the use of small enemata. Later small sips of very hot water frequently repeated may be given and still later small sips of cold water. There is danger in giving water too freely, and there is great danger in the use of large enemata.

9. All practitioners of medicine and surgery, as well as the general public, should be impressed with the importance of prohibiting the use of cathartics and food by mouth, as well as the use of large enemata, in cases suffering from acute appendicitis.

10. It should be constantly borne in mind that even the slightest amount of liquid food of any kind given by mouth may give rise to dangerous peristalsis.

11. The most convenient form of rectal feeding consists in the use of one ounce of one of the various concentrated liquid predigested foods in the market, dissolved in three ounces of warm normal salt solution introduced slowly through a soft catheter, inserted into the rectum a distance of two to three inches.

12. This form of treatment can not supplant the operative treatment of acute appendicitis, but it can and should be used to reduce the mortality by changing the class of cases in which the mortality is greatest into another class in which the mortality is very small after operation.

In regard to the first point, I wish to say here, as I have said everywhere before, so long as the infection is within the appendix when I make the diagnosis, I operate immediately if I can obtain the consent of the patient. I have stated the reasons why this should be done over and over again.

There is, however, a time that has been described by Dr.

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Niles, a time which comes to every surgeon, when we can not say with any degree of certainty that the particular patient under consideration will get well if we operate at once. This class of patients, under the best possible conditions, and with the best possible surgeons, will produce a mortality of from 15 to 30 per cent. if they are operated on at once as soon as the diagnosis has been made. I wish to say that with those cases we do not know what will happen if we operate at once. We do know, however, that in 97 per cent. of all such cases suffering from perforative or gangrenous appendicitis the patient will get well, provided we follow out the plan outlined in the above conclusions, namely, that of washing out the stomach, and giving absolutely no cathartics and no food of any kind by mouth and giving no large enemata until the patient has been normal for at least four days. We have counted the leucocytes and have found in all cases in which this treatment was carried out that the abnormal leucocytosis has decreased. We have found that the pain and the tympanitis disappeared regularly and that the patient's condition has improved systematically, and that although there is still a slight mortality, this has been diminished enormously by this form of treatment, not only in my own hands, but also in the hands of a large number of physicians and surgeons who have carefully carried out all of the details of this plan of treatment. Those who have failed have either permitted the use of a little food by mouth or they have neglected to employ gastric lavage or they have given large enemata.

Dr. Miles F. Porter, Fort Wayne, Ind.—We have operated in the beginning of the attack on several hundred cases and we have not lost a single case. We have counted these cases just as they come into the hospital; not only the cases in an operable condition, but those which died right after they entered the hospital. Some cases should be operated on after they recover from that attack, at a safe period of time. Occasionally we have a death, but we have only had 2 deaths this year out of 130 cases. Neither of these cases should have died, but the one died from pneumonia and the other from shock.

Dr. William J. Mayo, Rochester, Minn.—I think we are all agreed on one point—the point on which Drs. Murphy, Deaver and Ochsner, and so far as I know almost every prominent surgeon in this country has insisted—that if you can get the case within the first forty-eight hours that case should be operated on, and the sooner you operate the safer the operation will be. The more experience I have the more convinced I am that this is the proper course to pursue. Now, if you have a case that comes to you in which you believe that the inflammation is still confined within the appendix and the patient is still in a reasonably good condition, I do not care whether it is during the first forty-eight hours, or whether it

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is during the third, fourth or fifth day, I will operate on that case, because I believe that that case is going to get well. We have, at least out in Minnesota, a considerable number of cases brought to the hospital in which this favorable condition has gone by. The patient is tympanitic, vomiting, with quickened pulse, and we realize that no longer by removing the appendix can you get the material out of the system, and if you operate on this case at this time there will be a very considerable mortality. If you take these cases that show this septic condition (and Dr. Lund has shown us how to take care of some of the worst of them) and put them on the plan of treatment recommended by Dr. Oschner, in a few days the majority will get into a condition in which they can safely be operated on with a mortality of 4 per cent. or less; at least this has been our experience.

Dr. J. B. Murphy, Chicago—I feel that I have for the past two years understood Dr. Ochsner's position as he has stated it here to-day. I feel that the majority of practitioners have not properly interpreted his position, and that Dr. Ochsner has been greatly wronged and injured and maligned by many practitioners. I am delighted to find that we are practically a unit as to what should be done in cases of appendicitis. I do not see wherein we differ at all. There are cases, however, which we can not rescue by operation at the time they are brought into the hospital, which we can reach by operation at a later time. These cases are so small in number, however, in comparison with the whole, and the number will become smaller every day so soon as we understand that the profession is a unit, including Dr. Ochsner, that the cases are all better operated on within the first twenty-four or forty-eight hours, and that we ought to make a diagnosis before that time, and a practitioner will be ashamed to come in with a case after that time has elapsed. He can no longer say, "I have given this patient the 'Ochsner treatment,'" when the patient is presented in a moribund condition.

Dr. R. H. Gibbons, Scranton, Pa.—A bright, pretty girl, 16 years of age, a miner's daughter, was "attacked" during the evening of a Thursday of June last. A physician was called and prescribed for her, stating that she had a "bilious attack." On the following Tuesday I visited her in consultation, finding her abdomen enormously distended. It was recommended that she be taken into hospital that attempt might be made to get her in a more favorable condition for operation. I explained to her family the danger attendant on shifting her over the rough roads in one of the crude ambulances with which we are usually furnished throughout the coal regions, so she was not changed. I tried to have her physician appreciate the importance of keeping from her all forms of drugs, and even food or fluids, and to nourish her, if necessary, per rectum.

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This was an unsuccessful undertaking. At the end of two weeks, when I was again called, I found her condition was worse, if possible, than on the former occasion. I persuaded her family to have her removed at all hazard to a private hospital several miles distant; this was successfully accomplished. A rigid nursing surveillance was established, nothing was given by mouth, rectal alimentation was instituted. As is often noted to be so, when such patients are treated in this way the distension subsided, the peri-inflammatory exudate largely disappeared and the case assumed an altogether more favorable outlook, of which, when at its height, I proposed taking advantage, intending to operate. The already referred to danger attendant on attempt at gaining the interval opportunity now asserted itself. It was in this way: If the patient has done so well thus far why should she not make an entire recovery; in other words, why operate? These were questions that were put, not only by the little girl herself, but by various members of her family and others interested. While she was in this fairly favorable condition Dr. Robert F. Weir of New York City, while here in Scranton in consultation in another important surgical case, saw her with me, and said, as he had said at the meeting of a year ago, "that it was dangerous to postpone operation in any case." I regret exceedingly that I did not insist on operation at this time, for soon thereafter she was taken with symptoms which manifested themselves as those of pyophlebitis, and nothing whatever had the slightest effect on her condition, she finally dying on the forty-first day of her "attack." Dr. John A. Wyeth, who was in town spending a number of days in expectation of possible operation in a critical case of typhoid, also examined this case, but at a time when she was within a few days of her demise, when every organ in her body appeared to be under the influence of the general toxemia.

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A CASE OF ACUTE, NON-TRAUMATIC, MULTIPLE OSTEO-MYELITIS,

PRODUCED BY THE STREPTOCOCCUS, OCCURRING IN A MALE ADULT.

JOHN T. BOTTOMLEY, M.D.
BOSTON.

NARRATION OF CASE.

A. H. C., 43 years old, a theatrical manager, was born in France, lived most of his life in England, and had been five years in this country. His family history was negative. His previous history up to 1892 was not noteworthy. Though he had led an irregular life, with much excitement, travel and exposure, he had always been strong and robust. Venereal infection was denied; a moderate use of alcohol admitted. About 20 years ago he broke his left tibia at the junction of the lower and middle thirds, but it had given him no bother since.

Ten years ago he had an attack of "left-sided pleurisy" which lasted about six weeks. Though he soon recovered his normal weight and strength, he has since then had more or less pain in his left chest, a harassing cough, an almost constant bloody expectoration and the lower lobe of his left lung has been flat to percussion. These symptoms have always been exaggerated after prolonged physical exertion or mental worry. Occasionally, but only for a period of a few weeks at most, he would be free from them. Such a period occurred last spring, but the symptoms, returning in June, continued till his death. Several specialists, both here and abroad, had examined him, but a definite diagnosis had never been made. The uniformly bloody, prune-juice expectoration had been carefully examined again and again for tubercle bacilli, streptothrix, actinomyces and for neoplastic elements, but always with negative results. He had undergone, as a diagnostic measure, most thorough anti-syphilitic treatment without relief or change in his condition. His symptoms, subjective and objective, continued the same year after year. Repeated punctures at different times showed only a thickened pleura. No fluid, purulent or otherwise, was ever obtained, nor was a

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cavity in his lung ever demonstrated. A distinguished New York specialist who saw him a number of years ago had an opportunity of re-examining him last fall and found the physical signs unchanged, which rendered very improbable the diagnosis of a slow-growing malignant tumor of the lung which had once been advanced.

Aug. 1, 1902, while making a railroad journey, very sudden and severe pain began both in his left arm just below the shoulder and in his left leg about the middle. Though he had considerable fever (103), the severe pain was his only subjective symptom for several days; then he had a chill, a diarrhea started in and he began to feel "sick all over." A physician was called who reports that at that time (six days after the acute onset) there was "a swelling with deep pain on pressure over the inner surface of his left upper arm, at the junction of the middle and upper thirds. There was also deep induration over the outer aspect of the middle third of the left leg. Both arm and leg were swollen and the swellings were so tender that a thorough examination was impossible. There was no glandular involvements. The urine was negative; there was no temperature." Anti-rheumatics internally with local cooling lotions seemed to afford some relief for a day or two, but the pain then became more intense and the patient started a run of fever which varied between 100 and 102, but followed no definite type. Sweating now began, slight at first, but gradually increasing till it became a feature of his illness. A white count, made about the sixteenth day, showed a leucocytosis of 17,000. The patient became more and more ill; the temperature assumed a higher level and fluctuation finally appeared in the swellings on the arm and leg. A surgeon who saw the case in consultation at this stage opened the abscesses under local anesthesia, the patient's critical condition contraindicating a general anesthetic. The humerus and fibula were found to be partially denuded of periosteum, but "no connection with the bone marrow could be established." During the following month several operations were done on the left arm and leg to secure proper drainage. The symptoms, however, continued and the patient's condition grew gradually worse. His temperature varied from 101 to 103, while his pulse was about 125. A month after the onset of the disease his right forearm and right leg began to swell and to become tender and painful. An abscess over the upper part of the ulna was opened and drained; bare bone was once more found. The leg was not opened. The pus from all the abscesses showed the streptococcus in pure culture and the same organism was found in the expectoration. About the sixth week of his illness the state of the left arm became so bad that amputation was advised, but it was not done, partly because of the patient's unwillingness and partly because of his condition,

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which by this time had become so critical that even simple incision of an abscess under local anesthesia threw him into marked shock. For the latter reason a sequestrum which had formed in the left humerus was not removed. Numerous punctures into the flat area of the chest were made, but no pus was found. Yet a specialist in chest diseases who saw the patient in the sixth week of his illness diagnosed the chest condition as a pulmonary abscess.

Oct. 17, 1902, in the eleventh week of his illness, the patient came under my personal observation. He was emaciated and evidently septic. His temperature was running about 101.5, his pulse about 120. His respirations were only slightly accelerated. His chief subjective symptoms were his cough, severe pain in the left arm and right leg and moderate pain in his left leg and right forearm. His urine showed a slight trace of albumin, but was not particularly abnormal. He had an intermittent diarrhea which annoyed and weakened him greatly.

The whole left upper arm was swollen, thickened and edematous. On all its aspects were the wounds of his previous operations, some partially healed, some wholly open. From all came a free, foul-smelling, thick, purulent discharge; through all the examining finger could feel bare, roughened bone. The shoulder joint was involved in the process. The left forearm and hand were also swollen, but only as a result of the impeded return circulation.

On the external aspect of the left leg in its upper third was a partially healed wound about four inches in length. A sinus at its center led down to the fibula denuded of its periosteum over a considerable area. The discharge was not profuse. The upper half of the leg was only moderately swollen.

There was some general swelling of the whole right leg, but it was more noticeable over the lower half, especially just above the ankle joint, where there was marked edema and the tenderness was exquisite. The skin over this area was not reddened.

The right forearm was swollen from elbow to wrist, mostly posteriorly and on the ulnar side. Over the upper posterior surface of the ulna was a wound two inches long which, like the others, led down to bare bone and gave exit to a profuse discharge of thick pus. The elbow joint was apparently uninvolved, but was fixed at an angle of 45 as a result of its being held in that position for some weeks.

The rest of the story can be briefly told. At the first visit simple incisions were made in the right leg to relieve the tension and let out the pus. The previous incisions on the other members were lengthened to provide more effectual drainage. These procedures afforded so little relief that, after consultation with Dr. John C. Munro, radical measures were

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decided on, notwithstanding the critical condition of the patient. In two operations, one following ten days after the other, under general anesthesia, a very foul sequestrum six inches long was removed from the left humerus (the well-marked involucrum adding much to the difficulty of the operation), one about four inches long from the left fibula and another about two inches long from the right ulna; the right leg was freely opened and large areas of bare bone found on both tibia and fibula; the tibia was trephined and, pus having been found in the medullary cavity, a gutter was made with a chisel down the whole front of the cortex. The medullary cavity of the right fibula was opened with rongeur forceps and drained. It was not so extensively involved as the tibia. The right ulna was treated likewise and free drainage provided.

Necrosis of bone was very extensive in the left humerus and right tibia. There was a large quantity of foul, thick pus in the soft parts of the lower right leg. The periosteum was but little thickened over the upper half of the tibia, but was retracted from a large portion of the cortex of the lower half.

These operations brought the temperature down to normal for the first time in the course of the disease and there it remained till the end, save when backing up of the pus on two occasions caused a temporary rise to 101. The pulse also fell to the neighborhood of 100 and for two weeks following the operations the patient was very comfortable and spent part of each day in a wheelchair. But, unfortunately, recurrent attacks of diarrhea, the several operations necessary to maintain proper drainage, with possible advancing amyloid disease of his internal organs, so weakened him that he died early in January, 1903, on the one hundred and fifty-fifth day of his illness. Without doubt he had septicemia. An autopsy could not be obtained.

His fever was at its highest during the third and fourth weeks, touching 104.8 on the twenty-ninth day. It touched normal for the first time on the ninety-seventh day. The average temperature was about 101.5; the average pulse about 115; the highest rate reached was 140, coincident with the highest point of temperature. Except for a period of two weeks following the free opening of the bones, the patient was very restless and nervous, particularly at night. On and off a severe diarrhea gave him much trouble and was most difficult to control. He took very large quantities of nourishment throughout his whole illness and had very little gastric disturbance. Profuse sweats were common; chills were absent. During the course of his illness he developed a marked pilosis —a condition not uncommon in these cases. His cough was very troublesome and the expectoration always blood-stained, sometimes with dark, but more often with bright blood.

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The immediate cause of his death was cardiac failure, of which he had several attacks during the last two weeks of his illness.

COMMENTS ON THE CASE.

With regard to the diagnosis in the case there is but little to say. The long-standing affection of his lung, whatever may have been its nature, afforded to the streptococcus a focus of development in the body, a point of entrance to the circulation and a consequent opportunity to produce the unusual condition already described.

After the paper of Lexer[1] and that of Nichols, presented at the present meeting, there is at present nothing to be added to the bacteriology and pathology of osteomyelitis. This clinical contribution to the subject has reason for its being in these three factors: (*a*) the case showed multiple foci; (*b*) it occurred in an adult 43 years old, and (*c*) the infecting organism was the streptococcus.

Acute multiple osteo-myelitis, while not a very rare disease, is still by no means common. Funke[2] reported to the Surgical Congress in 1895 644 cases of osteo-myelitis; of these only 37 were examples of the multiple type. Neumark[3] reports 30 cases, five of which were multiple; Volkmann and Roser[4] consider the multiple form rare, and Wenzel reports a single case in a girl of 13. Haaga[5] says that one-fifth of all the cases are multiple. But, apart from the question of the rarity of this form of the disease itself, the fact that the present case occurred in an adult far removes it from the ordinary run of osteo-myelitis cases. Only 56 of Funke's 644 cases were found in patients over 25 years old. Of the 37 cases with multiple foci, all—without exception—occurred in children. In fact, he says that the multiple

1. Archiv für klin. Chir., Bd. lvii.
2. Verhandl. der deutsch. Gesellschaft für Chir., xxiv, Kong., 1895.
3. Archiv für Kinderheilkunde, No. 22, 1897.
4. Quoted by Wensel in Deutsch. Zeit für Chir., 1872, p. 410.
5. Beit. zur klin. Chir., 1889.

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form occurs only in children. Four cases mentioned by Volkmann[6] were all in patients under 14 years old.

In a fairly thorough search of literature I can find but one similar case of acute multiple osteo-myelitis occurring in an adult. H. F. Devel, in the proceedings of the Warsaw Society in December, 1885, reports the case of a soldier, 24 years old, who, in the course of a severe cold, developed osteo-myelitis foci in a rib and tibia synchronously; these were followed in the next three months by foci in six other bones. The infecting organism was not mentioned. Even this case comes on the border-line between youth and manhood.

Moreover, the case is noteworthy from the bacteriologic standpoint also. Lexer[1] in his exhaustive article (1896-1897) collected only 20 cases of osteo-myelitis in which the streptococcus was the infecting organism; 10 of these had been previously reported to the French Surgical Congress by Lannelongue.[7] Lexer remarks that the streptococcus, like the staphylococcus, shows a marked tendency to develop in the bones of the young. Lannelongue's cases varied in age from 10 days to 13 years. Of Lexer's 10 cases 8 were under 14 years of age.

In the examination of the pus from 73 cases of osteomyelitis Lannelongue and Achard[8] found the streptococcus alone only 7 times.

Lexer has demonstrated that the clinical course of cases of streptococcus osteo-myelitis may not be unlike that of a staphylococcus infection. He divided streptococcus infections into three groups, in the first of which —containing those cases in which phlegmon was very marked in the affected bone and sequestration was found —the present case falls. Clinically it does not differ in any important item from the cases caused by the staphylococcus. Before Lexer wrote his paper Lannelongue had recognized a difference both clinically and anatomically

6. Canstatt's Jahresbericht, 1869.
7. Revue de Chir., 1895, p. 895.
8. Pl. Mauclaire in Traite de Chir. (Dentu et Delbert), 1896, vol. xi, p. 520.

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between the streptococcus and the staphylococcus infections, and the symptomatology of the present case illustrates the fact (mentioned by Lannelongue) that both the fever and the pain in the streptococcus cases are apt to disappear on the third or fourth day. The improvement, however, is only temporary. Both symptoms return again.

It seems to be generally agreed that the pus in streptococcus cases is thinner and the necrosis of bone and soft parts less than in the cases of staphylococcus infection.

Klemm[9] says that a widespread phelgmon of the medulla is rare in streptococcus cases and that edema of the soft parts is of wide extent. Because a single case can not be maintained as the standard, the fact that the pus in the present case was thick and that the medulla was widely involved is of no particular importance. Besides, secondary infection was present at the time I first saw the case.

But let the clinical or the pathologic or the bacteriologic aspects and differences be as important as they may, the fact remains that the important and imperative thing, the factor that means most to us and to the patient, is an early diagnosis. An early operation must follow an early diagnosis. The old principle of "Where there is pus, open and drain" holds here. Pus is in the medullary cavity and it is the medullary cavity in the acute cases that must be opened and drained, that results may be achieved. Doing less than this is doing nothing. Temporizing, when a diagnosis has once been made, is criminal.

9. Quoted by Bloodgood in Prog. Med., December, 1899.

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ACUTE, SUBACUTE AND CHRONIC INFECTIOUS OSTEOMYELITIS;

ITS PATHOLOGY AND TREATMENT.

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BOSTON.

INTRODUCTION.

The object of this paper is to state the sequence of the changes which occur in the bones in infectious osteomyelitis; to emphasize the difference in the pathologic conditions which exist during the acute, subacute and chronic stages of the disease; and especially to suggest certain operations which are indicated by the pathologic conditions that exist during the different stages, and which generally are not appreciated. These operations, properly carried out, offer a very certain cure for conditions which, if allowed to persist, cause recurrent attacks of local infection or produce chronic and frequently incurable destruction of bone with permanent disability.

The statements made here are based almost entirely on personal work carried on for the past eight years. The work has included examination of pathologic material obtained from operations or necropsies on cases occurring at the Boston City Hospital and the Children's Hospital, experimental work at Harvard Medical School, and clinical cases, most of which were seen during my own tour of duty at the Boston City Hospital. A few

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other clinical cases have been furnished by the great kindness of my colleagues on the hospital staff, who have allowed me to see the patients and present the records of the cases.

DEFINITION.

Infectious osteomyelitis is an acute suppurative inflammation of the bone, and is always due to infection of the bone marrow by pyogenic microörganisms. The process is essentially like the process seen in a furuncle, and has been graphically called "bone furunculosis," although the process in bone is somewhat modified by the peculiar anatomy of the tissue. In bone the process begins in the marrow of the alveolar spaces, which communicate freely with each other, but are enclosed by a dense shell of cortical bone. Hence the process, at first circumscribed, may quickly involve the entire marrow of an infected bone, because the products of bacterial infection are retained within a shell of dense bone, and the primary focus can be reached only by an extensive bone operation.

CAUSE.

The direct cause of acute infectious osteomyelitis is always an infection by some pyogenic bacterium. The organism which most frequently is the cause is the *Staphylococcus pyogenes aureus,* e. g., Lannelongue[1] and Achard[2] found that of 130 cases of osteomyelitis 103 cases gave a pure culture of that organism. In some thirty primary cases of my own all but four were due to the same organism. The staphylococcus produces, as a rule, the most typical and extensive bony destruction. Sometimes the *Staphylococcus albus* or *citreus* is present in pure cultures, and Lexer[3] says that the character of

1. Lannelongue: Statistique Microbienne de l'Ostéomyélite Aiguë. Rev. de Chir., 1895.

2. Lannelongue and Achard: Sur le Présence du Staphylococ. Citreus dans un Ancien Foyer d'Ostéomyélite. Arch de Med. Exper. et d'Anat. Path., 1892.

3. Lexer, E.: Die Aetiologie und die Mikro-organismen der akuten Osteomyelitis. Volkmann's Klinische Vorträge, N. F., 173, p. 659.

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the lesions is the same as that of those produced by the aureus, and the lesions can not be distinguished clinically. The bone lesions frequently are secondary to suppurative lesions elsewhere in the body, e. g., furuncle or carbuncle, and the organisms are carried to the bones by the blood.

In a few cases the infectious organism is the *Streptococcus pyogenes.* In some cases the lesions produced by the streptococcus are like those produced by the staphylococcus and can not be distinguished clinically, but these cases are rare.[3] As a rule, the streptococcus has a tendency to affect the joints, to cause separation of an epiphysis, or to attack the superficial portion of the bone and cause a periostitis rather than a diffuse osteomyelitis. Such bone infections frequently occur in infants from mothers with septicemia, and may be due to infection during delivery. Or they may be secondary to phlegmon or erysipelas. Osteomyelitis produced in young animals by inoculation with streptococcus does not differ from that produced by the staphylococcus.

In still other cases[4] Fränkel's pneumococcus causes osteomyelitis. The appearance and distribution of the lesions vary, but on the whole the tendency is the same as in the case of the streptococcus, i. e., to a superficial or joint infection. These cases may occur secondary to pneumonia, pleurisy, or empyema, or the point of primary infection may be hidden.

Not infrequently the typhoid bacillus may cause suppurative areas in bone, and Keen[5] has collected thirty-eight such cases, in fourteen of which the bacillus was present in pure cultures. As a rule, such lesions are of small extent and superficial and the destruction of the marrow is slight unless a secondary infection with some

4. Fischer and Levy: Bacteriolog. Befund bei Osteomyelitis und Periostitis., Deutsch. Zeitschr. f. Chir., 1893.

5. Keen: Surgical Complications and Sequels of Typhoid Fever, 1898.

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pyogenic organism occurs. The cases generally occur quite late in the course of typhoid fever.

As a rule, the infecting organism is present in pure culture, but sometimes a mixed infection occurs, and such cases are said to be especially severe. In cases of chronic osteomyelitis with open sinuses and exposed bone a great variety of organisms, pathogenic and saprophytic, may be present. In one such case with a very foul-smelling discharge, I found the *Bacillus fetidus.* Secondary infections with the colon bacillus, the pyocyaneus and anthrax have been reported.

Therefore, infectious osteomyelitis is not a specific disease, but is an acute inflammation of bone that may be produced by any one of a variety of pathogenic organisms, or by a mixed infection. Any[5] pyogenic organism which can be carried in the blood stream may be deposited in the bone and produce suppuration. Some show great tendency to such an action, others but little; some settle by preference in the bone marrow, others at the periphery in the periosteum or in the joints; some tend to act at the point of greatest bone activity, others at points of injury.

Experimental Proof.—This has been proved by experiments on animals by many observers. Characteristic osteomyelitis has been produced in the bones of animals by injection of pyogenic organisms into the nutrient arteries of the bones, or by direct injection of organisms into bone marrow, or by fracturing bones and inoculating animals subcutaneously. For such inoculation experiments the *Staphylococcus pyogenes aureus,*[6] the *Streptococcus pyogenes,* the pneumococcus and the typhoid bacillus have been used. Ackermann[7] has produced it by injecting large numbers of the colon bacilli. Ullman produced "sterile abscesses" in bone by injecting

6. Lexer: Experiment. Erzeugung osteomyelitischer Herde. Dtsch. Med. Wochenschr., xvi, 1894; also, Ullman: Beiträge zur Lehre von der Osteomyelitis acuta. Wien.

7. Ackermann: Lésions Ostéomyélitiques provoquées par le Bact. Coli Comm., Arch de Med. Exp. et d'Anat. Path., 1895.

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an emulsion of calomel directly into the marrow. The gross and microscopic appearance of the experimental lesions was the same, no matter what the cause.

PREDISPOSING CAUSES.

Certain general causes favor the occurrence of osteomyelitis. The disease usually occurs in individuals whose bones have not attained complete development, i. e., in children or adolescents, although it is not rare in adults, and sometimes occurs in advanced life, as shown in a case reported by Bottomley.[8] About one-half of the cases occur between the ages of thirteen and seventeen, although young children often are infected. The disease is said to occur in boys about three times as often as in girls. The disease frequently appears after extreme fatigue, or exposure to cold or wet. One of the cases mentioned later came on within a few days after bathing in cold water in early spring. Injuries of moderate severity, e. g., contusions of bones, frequently precede the disease by so short a time as to suggest a possible cause, although there may have been no break in the skin. A preceding attack of some infectious disease is often noted, e. g., measles, scarlet fever, pneumonia, or frequently typhoid fever. Osteomyelitis which follows infectious diseases usually is due to a secondary infection by some pyogenic organism, e. g., staphylococcus, although both the pneumococcus and the typhoid bacillus may be the direct cause of the bone lesion. The frequent occurrence of osteomyelitis subsequent to the exanthemata probably is due to lowered resistance to bacterial infection as a result of the infectious disease, as well as to the septicemia frequently present in those diseases. Mallory has shown that in smallpox[9] and typhoid fever[10] areas of necrosis are frequently present in

8. Bottomley, J. T.: Acute, Non-traumatic Multiple Osteomyelitis Due to the Streptococcus in an Adult, THE JOURNAL A. M. A., July 25, 1903.

9. Mallory, F. B.: Ueber die Verbreitung der Osteomyelitis variolosa im Knochensysteme., Zeitsch. f. Heilkunde, vol. xv, 1894.

10. Mallory, F. B.: A Histologic Study of Typhoid Fever, Jour. Exp. Med., iii, p. 611, 1898.

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the bone marrow, and such areas, secondarily infected by pyogenic organisms, may well be the starting points of acute suppuration of the marrow.

Compound fractures frequently become infected by pyogenic organisms, and the bone undergoes osteomyelitic changes. In former days such infections frequently were fatal. Under modern methods the infection when it occurs generally is slight, and, since the pus usually can readily escape through the wound in the soft tissues, the results are seldom fatal, although the destruction of bone by the infection may be sufficient to greatly delay healing, and to lead to the formation of small sequestra and enduring sinuses. Sometimes the same result follows infection of bone stumps after amputations.

METHOD OF INFECTION.

The infection of the bone often is secondary to a local infection in some other part of the body, e. g., furuncle, paronychia or chronic ulcer, and the organism carried from such a focus by the blood produces infection of the bone marrow. In some cases the organism enters the body through the respiratory tract, as when an osteomyelitis produced by the pneumococcus occurs subsequent to a pneumonia, pleurisy or empyema. Infection may occur through the intestinal tract, as when osteomyelitis is produced by the typhoid bacillus, although other types of intestinal infection are said to be rare. Ullman[6] fractured the bones of animals and then fed them with infected food, but failed to produce infection of the bone. Frequently the osteomyelitic focus appears to be the only point of infection and it may be quite impossible to detect the primary point of entrance of the infective organism.

LOCATION.

Osteomyelitis nearly always begins in the diaphysis of the long bones, usually near the epiphyseal line. This is in sharp contrast with tuberculosis of bone, which, in the large bones at least, practically always begins in the epiphysis. Rarely, however, osteomyelitis is said to be-

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gin in the epiphysis, and so to simulate acute tubercular disease. It is my belief that such cases usually begin in the diaphysis, perforate the epiphyseal line very early, and then extend to the joint. The femur and the tibia are the bones most frequently attacked, then the humerus, but no bone is exempt, and short long bones, e. g., the phalanges or flat bones, may be affected. Usually only one bone is diseased, but sometimes several bones are affected. After one bone is diseased other bones may become involved after an interval of days or weeks. Multiple osteomyelitic lesions are, however, not common.

PATHOLOGIC PROCESS.

The primary area of infection is always, apparently, in the bone marrow. The bony trabeculæ and the cortex are destroyed only secondarily, and their destruction and solution is usually slight in the early stages, although in the later stages the destruction may be very extensive. The process almost always begins in the diaphysis of the long bones, frequently near the epiphyseal line. Rarely, however, the process is said to begin in the epiphysis, and then may extend into the adjacent joint early. After the organisms gain access to the marrow cells they multiply and produce a soluble toxin which causes necrosis of the adjacent marrow cells. Since the cortex is relatively impermeable while the marrow spaces allow free communication and extension of the infection, necrosis of a very considerable portion of the marrow of a long bone may take place before marked purulent infiltration occurs. In such a case the marrow may appear gelatinous and injected to the naked eye, while under the microscope the marrow cells everywhere are necrotic, and among them are numerous colonies of the infecting organism. As a rule, purulent exudation of polynuclear leucocytes with extensive solution of marrow cells appears early. Then the bone is, on being sawed open, mottled with numerous yellow or greenish areas of suppuration, together

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with reddened areas of injection or hemorrhage. Solution of the soft tissue of the marrow is usually great. Sometimes even in the early stages there is some solution of bony trabeculæ, with the formation in the spongy bone of cavities containing serum, necrotic cells and leucocytes. Hence "bone abscesses" appear, but these usually are small. The infection may very rapidly extend along the entire marrow canal of a long bone. The extension, however, is always more or less irregular, apparently because of the irregular communication between adjacent alveolar spaces, due to the irregular arrangement of the bony trabeculæ, so that the bone nearly always shows a mottled red and yellow appearance from the presence of necrotic and injected and purulent areas, while small areas of relatively unaltered marrow may persist in close proximity to the altered areas.

The infection usually extends quite early through the dense cortical bone, probably along the haversian canals, and produces an inflammatory exudation and suppuration between the periosteum and the outer layer of cortical bone, i. e., a subperiosteal abscess, and may strip the periosteum from the bone over a great extent or completely. The infection may also extend to adjacent soft tissues, and cause myositis, or a subcutaneous inflammation, or an abscess. Such an abscess may be very extensive, and has direct communication with the marrow of the bone, although the point of communication may not be detected readily. Finally such an abscess may extend to the surface and break through the skin at one or more points, although such an event rarely occurs spontaneously in severe cases, since fatal toxemia and septicemia frequently occur before spontaneous evacuation. If such a spontaneous evacuation does occur, sinuses leading down to dead bone may persist indefinitely.

As a rule, the infection is checked and confined to the diaphysis by the epiphyseal line. In some cases, however, especially in older children or adults in whom the

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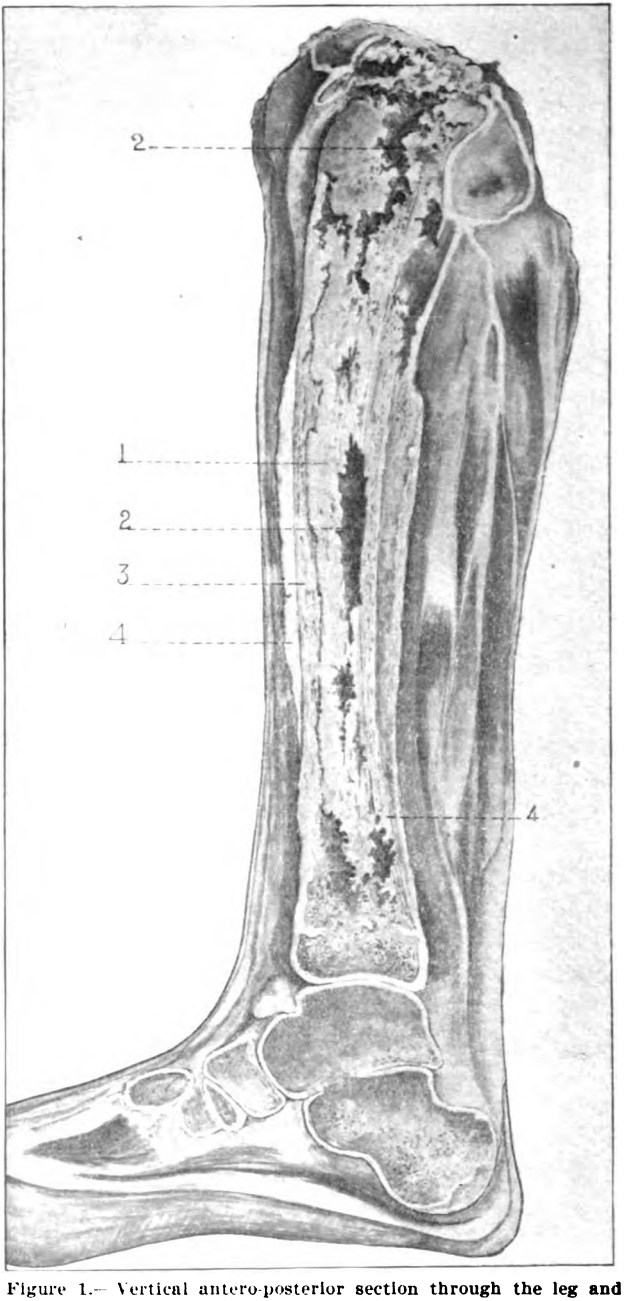

Figure 1.— Vertical antero-posterior section through the leg and foot of a case of infectious osteomyelitis. Duration about seven weeks. 1. Areas of suppuration. 2. Areas of injection and granulation tissue. 3. Necrotic cortical bone. 4. Newly-formed periosteal bone, but still plastic. This is the best stage for the operation. Upper epiphysis invaded by suppuration. Below process checked by epiphyseal line.

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epiphyseal line is partly or completely ossified, the infection extends through the epiphyseal line, involves the epiphysis, and then may extend to the joint and produce a purulent inflammation of the synovial cavity and more or less complete destruction of the joint. Or there may be a destruction of the epiphyseal line and a separation of shaft and epiphysis—"spontaneous fracture."

The cortical bone usually becomes necrotic over considerable areas. The extent to which cortical necrosis occurs depends partly on the extent of the destruction of the endosteum and partly on the amount of separation of the periosteum from the shaft. If the periosteum is stripped from the cortical bone for any great extent, necrosis of at least the outer layer of the underlying cortical bone is likely to occur. On the other hand, if much of the endosteum which lines the shaft and covers the trabeculæ is destroyed by the inflammation, a corresponding necrosis of the inner layers of the cortex or of the trabeculæ will occur.

If the periosteum is separated from the cortical bone about its entire circumference, as frequently happens in these cases, necrosis of the entire circumference of the cortex, at least in its superficial layers, may occur. If, internally, the entire circumference of the endosteum is destroyed, the entire inner circumference of the cortex may become necrotic, at least in its inner layers. If periosteum and endosteum both are affected at any given level, a complete necrosis of the shell of cortical bone may occur. Since the amount of destruction of the endosteum and the extent of the stripping of the periosteum vary greatly in individual cases, the extent of necrosis of the cortical shell also varies within very wide limits. Sometimes the entire shaft of cortical bone may be destroyed relatively early in the disease. In other cases only a long sliver of the outer layer of the cortex may become necrotic, and ultimately be separated as a sequestrum, without ever opening into the marrow cavity.

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In nearly all cases, because of the impermeability of the cortical bone and the consequent rapid extension of the suppuration over a large extent of marrow, the area of suppuration from which absorption takes place is large, the difficulties in the way of spontaneous or artificial evacuation are great, while symptoms of toxemia and septicemia appear early and are extreme.

REPAIR.

If from spontaneous evacuation of the abscesses, or from operation, a fatal result is avoided, the infectious process may become limited and the process of repair may begin. The reparative process produces peculiar and important gross pathologic conditions, due to the peculiar anatomic conditions found in bone. In general, repair within the shaft is brought about by the formation both of granulation tissue which arises from the reticulum of the marrow, and of new bone which arises from the endosteum. As a rule, a portion of the infected marrow and cortex becomes necrotic over a greater or less extent and persists, for a time at least, as a bony "sequestrum." Outside of the shaft the periosteum becomes more or less separated from the underlying necrotic shaft, proliferates, and produces a shell of new bone, which surrounds the necrotic original shaft with a shell of new bone,, i. e., forms an "involucrum." An understanding of each of these steps demands an accurate consideration of the process of repair of normal bone, as studied in experimental lesions in animals.

REPAIR OF UNINFECTED EXPERIMENTAL FRACTURES.

The process can best be studied in bones in which a loss of bony tissue is produced without dislocation of the fragments, e. g., by drilling a small hole vertically into the bone. In this way the process of repair can be studied without the complications which arise in complete fractures.

In such fractures hemorrhage occurs, followed in a few hours by an inflammatory exudate. By the second

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Figure 2.—Transverse section through a ver
loose fragments of bone and granulation tissue.
bone; no proliferation of this dense bone. 4. Int
partly preformed cartilage, and partly direct bony
7, 7. Cortex of femur.

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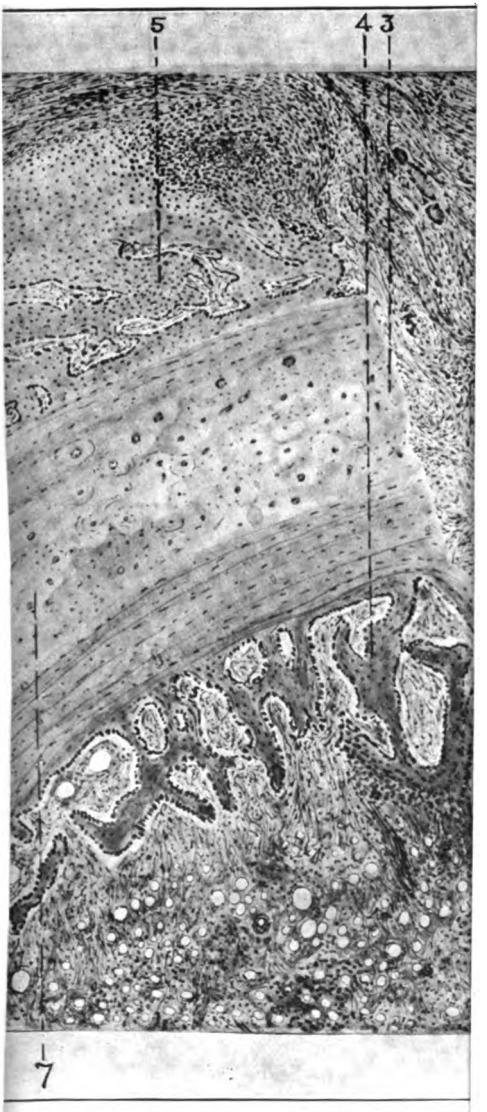

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day reparative proliferation occurs. The proliferation occurs within and outside of the cortex of the bone. The external proliferation arises from the periosteum, and consists of a mass of epithelioid cells, which soon become spindle-shaped and are accompanied by young blood vessels derived from adjacent blood vessels. This mass of cells forms the early "external callus." The internal proliferation arises partly from the layer of cells lining the inner surface of the cortex (endosteum) and partly from the connective tissue reticulum of the marrow, and forms a mass of cells in the shaft similar to those produced by the periosteum. This mass of cells forms the early "internal callus." By the fourth day a homogeneous intercellular substance appears between some of the cells of the internal callus, the early "osteoid" tissue. Fusion of adjacent areas of such osteoid tissue forms the early outline of new trabeculæ in the internal callus. Some of the proliferated cells are included in the osteoid areas, and are converted into the bone corpuscles of the osteoid trabeculæ, while others of the cells assume a polygonal shape, persist at the periphery of the trabeculæ and take on the function of depositing bone, i. e., become "osteoblasts." The cells which carry on these functions apparently are derived from the cells which arise from the endosteal cells, although in the early stages they can not be distinguished morphologically from the fibroblastic cells derived from the connective tissue reticulum of the marrow. Ultimately there comes a deposit of lime salts in the osteoid trabeculæ of the internal callus, and so the bony trabeculæ are formed. Besides the proliferation of endosteal cells there is a proliferation of the connective tissue of the marrow reticulum, and fibroblastic cells, which ultimately forms a scar within the cortex, are produced. New blood vessels arise from preëxisting blood vessels.

A formation of bony trabeculæ in the external periosteal callus takes place in an exactly similar way.

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The cortical bone in experimental fractures seems to have very limited or no power of proliferation, and the space in the cortical bone at first is filled with hemorrhage and exudation only, until the external and internal calluses project in from either side, meet, and fuse. After the fusion, new trabeculæ appear in the gap in the cortical bone. These are at first entirely free from the cortical bone, but finally become fused

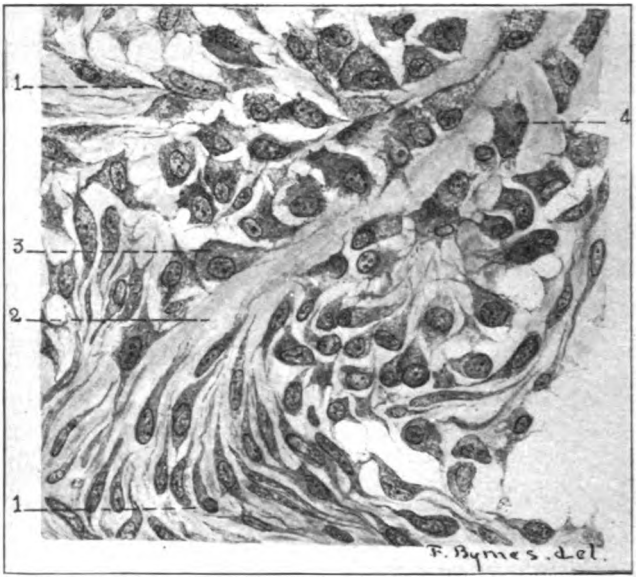

Figure 3.—High power of cells derived from endosteum showing formation of early osteoid trabeculæ. 1, 1. Epithelioid cells, with fibrillar intercellular material. 2. Intercellular material becoming homogeneous, previous to deposit of lime salts, "osteoid" trabecula. 3. Epithelioid cell on surface of osteoid trabecula, "osteoclast." 4. Epithelioid cell retained in osteoid trabecula, to become "bone corpuscle."

with the calcified portion of the cortex and thus form the "intermediate callus."

At first the newly-formed osteoid or osseous tissue is very vascular and formative osteoblasts are numerous. Later the blood vessels are much less numerous, the cellular elements are fewer, and the trabeculæ become

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laminated and have the same appearance as in normal bone.

REPAIR IN OSTEOMYELITIS.

The general process in the repair of osteomyelitic bone is the same, but some of the special steps are modified by the degree, extent and character of the destructive process and by the persistence of the sequestrum. The steps will be described as they occur in the marrow, the cortex and the periosteum. It should be borne in

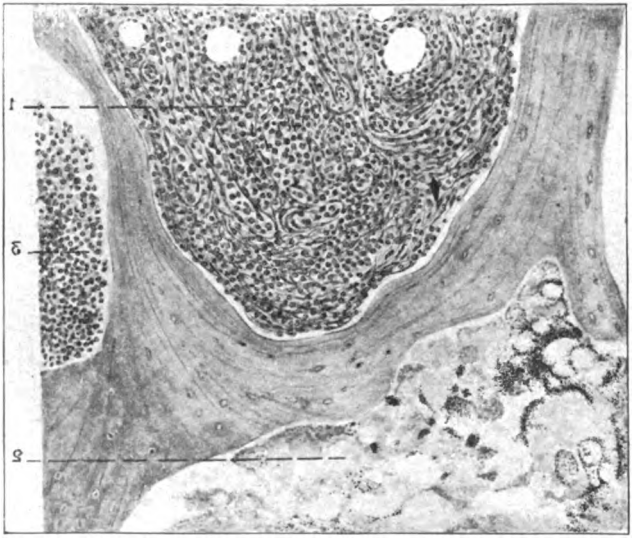

Figure 4.—Adjacent alveolar spaces in marrow of osteomyelitis of tibia, duration about ten days. 1. Alveolus filled with granulation tissue. 2. Alveolus filled with serum and entirely necrotic cells, among which are numerous colonies of staphylococci. 3. Alveolus filled almost entirely with polynuclear leucocytes.

mind that the endosteum covers all of the calcified trabeculæ as well as the inner cortical wall.

Marrow.—As has been mentioned, adjacent marrow spaces in the early stages may be normal, or show slight necrosis with little leucocytosis, or may be entirely necrotic, or the cells may be dissolved and the space filled with purulent exudation. Consequently the

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amount of proliferation in adjacent spaces after repair begins may vary a great deal.

The connective tissue of the reticulum of the fat marrow may proliferate to a great degree, and surround purulent areas with a more or less complete zone of granulation tissue, or in some cases may entirely fill up the marrow spaces at a given level, and so form a band of at first granulation, later dense scar tissue, thus separating the necrotic and infiltrated portion of the shaft from the sound portion. In a case of spontaneous osteomyelitis the scar tissue is likely to be irregularly distributed throughout the shaft surrounding the infiltrated areas. In compound fractures especially a definite transverse zone of granulation or scar tissue often separates the infected portion from the sound shaft. At first the granulation tissue may be edematous and show infiltration with lymphoid and plasma cells and numerous leucocytes. Later it becomes dense scar tissue. If a definite abscess has formed, it may be completely surrounded by a zone of scar tissue.

Beside the proliferation of connective tissue from the reticulum there may be a proliferation of the endosteum both from the inner wall of cortical bone and from the endosteum covering any of the trabeculæ. This may lead to a deposit of bone on the inner wall of the cortex, and to a thickening of the bony structure of the old trabeculæ, or to the formation of new trabeculæ. If such endosteal proliferation takes place it leads to a thickening of old bony structures and a formation of new ones which may surround infiltrated or necrotic areas with a wall of bone of increased density, or form a barrier of bone between necrotic and sound portions of the shaft; or, if the abscess is a local one, may entirely surround such an abscess, or may lead to an obliteration of the marrow canal at a given point.

Since the extension of the destructive process is very irregular, the distribution of the granulation tissue and endosteal bone may be correspondingly irregular, and

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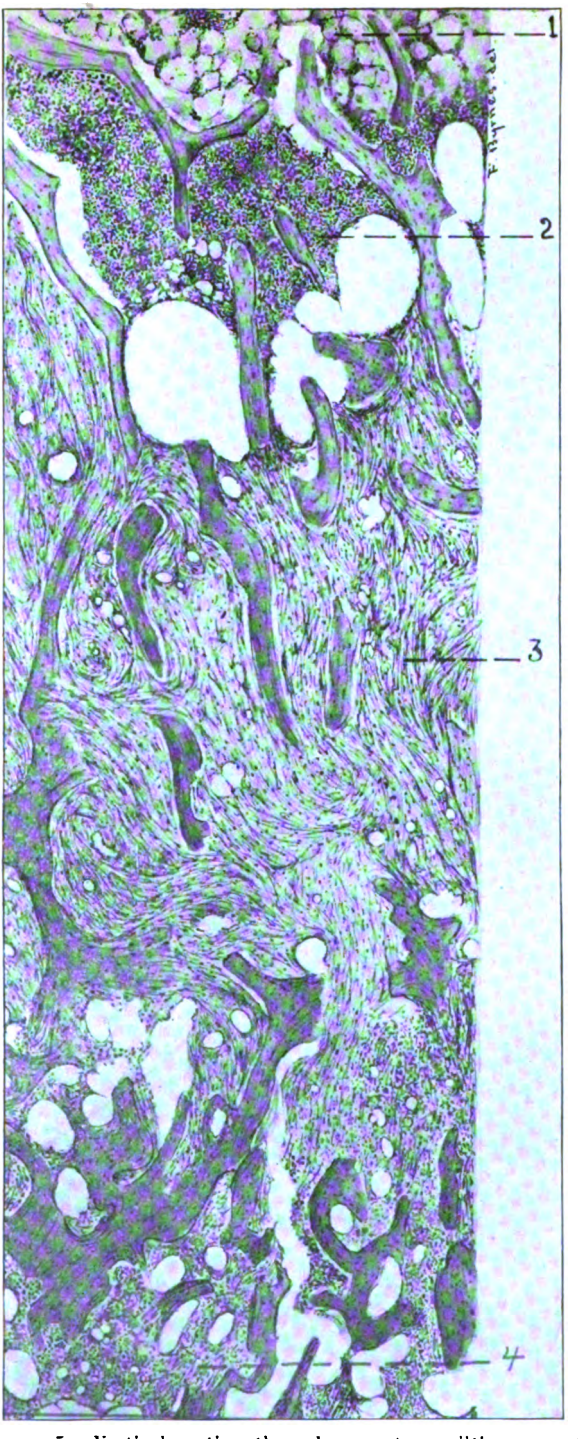

Figure 5.—Vertical section through an osteomyelitic compound fracture. 1. Alveolar spaces filled with necrotic cells and serum, with many colonies of staphylococci. 2. Zone of polynuclear leucocytes in alveolar spaces. 3. Zone of scar tissue filling alveoli and separating infected bone from (4) normal red marrow and granulation tissue in alveoli.

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may be diffusely scattered throughout the bone, may cause bony or fibrous encapsulation of diseased areas, or may divide diseased areas from sound portions of the shaft.

Cortex.—As has been said in discussing the repair of experimental fractures, dense cortical bone has very little or no power of direct repair. Repair of any considerable amount of necrosis of cortical bone depends entirely on the integrity of the endosteum within, and the integrity and adhesion of the periosteum to the outside of the cortical bone. If the endosteum is intact, the inner layer of the cortical bone may retain its vitality. In some cases in which the periosteum is entirely stripped from the underlying cortex, the cortex at the time of operation may appear white, non-vascular and necrotic; but if the pus is entirely removed, it is certain that to a considerable extent the periosteum returns to its normal position, becomes adherent to the apparently necrotic cortex and maintains or renews its vitality. This adhesion of periosteum may be complete over the entire shaft, or more commonly takes place over only a part of the shaft, and fails to take place in other portions. This partly explains the occasional very irregular distribution of the necrosis of the cortical bone as seen in some sequestra.

The necrosis and inability to repair of the cortical bone is the chief cause of the persistence of sequestra and sinuses as seen in chronic osteomyelitis. The marrow has considerable power of repair, but the cortex, if necrotic, persists as a sequestrum, and either remains indefinitely, or is discharged piecemeal, or must be removed by operation; and in either case, leaves a cavity which has usually no power of closing itself.

Periosteum.—As soon as the pus has been evacuated and the inflammatory process has subsided the periosteum proliferates and endeavors to maintain the vitality of the outer layer of cortical bone, or produces new bone to replace that destroyed by the inflammation. As al-

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ready mentioned, in some cases to a considerable extent the periosteum, after the pus is evacuated, again comes in contact with and adheres to the cortical bone, and the cortical bone beneath such adhesions retains its vitality. This explains the adherence of the periosteum

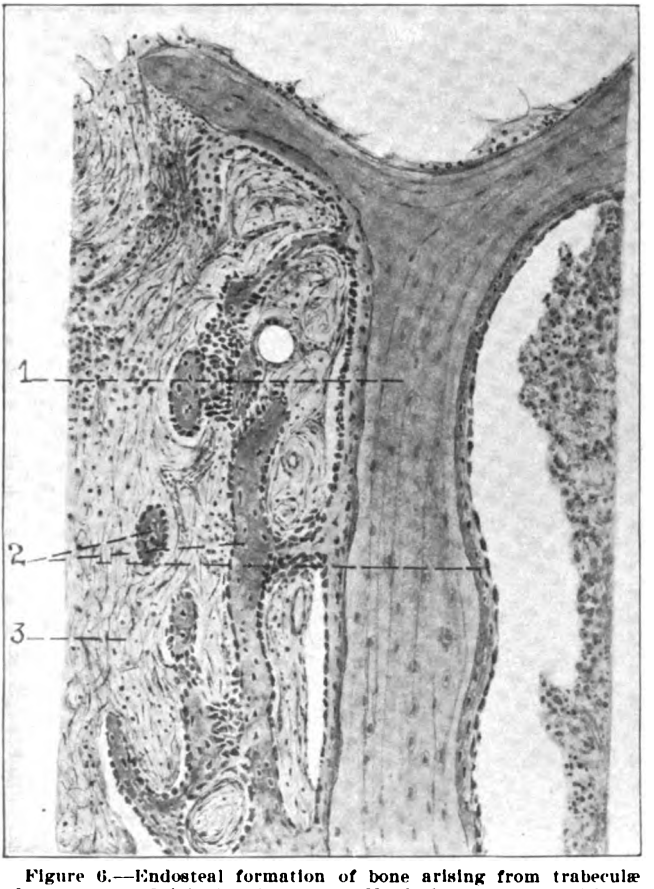

Figure 6.—Endosteal formation of bone arising from trabeculæ of marrow. 1. Original trabecula. 2. Newly-formed endosteal bone, partly adherent to original trabecula, partly appearing as new trabeculæ. 3. Alveolar spaces with granulation tissue arisen chiefly from reticulum of marrow.

in places to an extensive sequestrum, which throughout most of its extent is completely separated from the periosteum.

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In most cases, if the periosteum has been stripped to a great extent, this adhesion between periosteum and cortex does not take place. But the periosteum undergoes a process of proliferation analogous to that seen in the formation of the external callus in fractures. The cells of the periosteum next to the necrotic cortex are polygonal and are the bone-forming cells. Between adjacent cells a homogeneous intercellular substance appears, early "osteoid" tissue, and by fusion of such intercellular material the outlines of early osteoid trabeculæ are formed. Some of the polygonal cells are enclosed in the osteoid tissue, become branched and take on the function of bone corpuscles for the new trabeculæ of osteoid tissue. Other cells remain in contact with the outer surface of the new trabeculæ and take on the function of bone deposition on the outer surface of the trabeculæ, i. e., become "osteoblasts." In this way the deep layer of the periosteum becomes converted into a thin layer of delicate new periosteal bone, usually separated from the necrotic cortical bone sequestrum. The further development of bone in the periosteum takes place peripherally, the deep layer of the membrane forming bone, the intermediate layer producing polygonal, bone formative, periosteal cells, while the peripheral layer consists of layers of spindle cells, such as are seen in normal periosteum.

In the early stages the spaces between the newly-formed trabeculæ are filled with a rather myxomatous mass of cells, usually somewhat polygonal or stellate, with very delicate intercellular fibrillæ, usually very edematous. Among these cells lymphoid and plasma cells are very numerous, and occasional leucocytes are seen. Young blood vessels are numerous.

As the periosteum continues its peripheral growth with the formation of new periosteal bone, the old necrotic shaft finally becomes surrounded by a shell of newly formed periosteal bone, which, as a rule, is perforated at one or several points by sinuses for the dis-

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charge of pus from the necrotic shaft, i. e., an "involucrum" surrounding a "sequestrum" is formed. The sequestrum may lie entirely free, or, as already mentioned, may be adherent to the inner layer of periosteal bone to a greater or less extent. If there is a free space

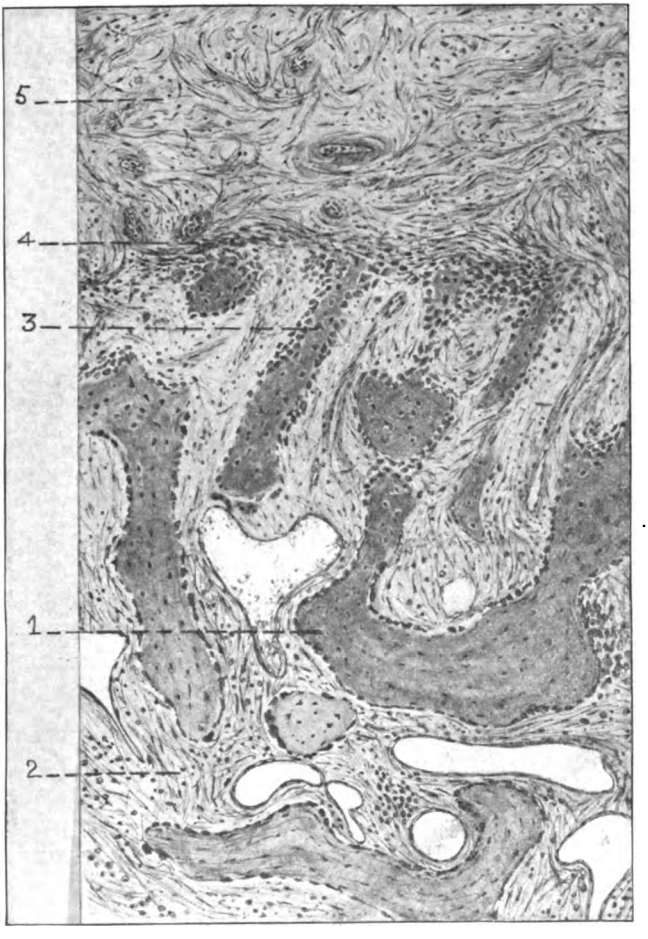

Figure 7.—Section through cortex and adherent new periosteal bone in osteomyelitis, duration about seven weeks. 1. Cortical bone trabeculæ. 2. Marrow spaces filled with granulation tissue. 3. Newly-formed periosteal bone trabeculæ. 4. Osteogenetic layer of periosteum. 5. Fibrous layer of periosteum.

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between sequestrum and involucrum the inner layer of the involucrum is lined by a layer of edematous granulation tissue from which a discharge of pus may continue indefinitely.

At first the periosteal bone is soft, partly osseous and partly osteoid, and very vascular, with myxomatous tissue in the alveolar spaces. The process of periosteal bone formation does not continue indefinitely, but continues only until sufficient new bone is formed to carry on the function of weight-bearing, i. e., at first the total diameter of new bone is greater than the diameter of the necrotic shaft was. This increase in diameter over that of the normal shaft is apparently due to the fact that the new bone is softer than normal bone, and consequently more of it is required to support a given weight than would be needed if the bone were normal. Later, as the new bone becomes denser and more like normal bone, there is a definite decrease in size of the periosteal shell, so that the total diameter of the shell may closely or exactly approximate the diameter of the original shaft.

In time the trabeculæ of the involucrum become completely ossified and osteoblasts become flattened out and approximated to the trabeculæ as an endosteum, just as in normal trabeculæ; the myxomatous granulation tissue becomes converted into fat marrow; and the entire involucrum assumes a structure like that of normal dense cortical bone or in some cases like the spongy bone of the epiphysis. Such dense bone has, just as cortical bone has, a very limited power of repair. Hence if at this late stage the sequestrum is removed, it leaves a cavity with walls composed of dense bone like cortical bone, which has very limited or no power of repair. This explains why cavities which are left after the removal of sequestra so often persist indefinitely and fail to close. This is especially the case if, at the same time the periosteal shell is forming, the marrow canal is closed by a plug of dense marrow bone, which arises by en-

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dosteal bone formation, or by a band of scar tissue which is converted by metaplasia into dense bone.

GROSS APPEARANCE.

Marrow.—The gross appearances of osteomyelitic bone vary with the histologic conditions already described. In the acute stage, marrow is first affected. If examined very early, no suppuration may be seen. The marrow simply is infected and necrotic. At that time it appears injected and gelatinous. At that stage, during an operation, it may be impossible on account of the hemorrhage to be certain that any gross change is present. Usually, however, cases are not seen until suppuration is well marked. Then on opening the marrow a profuse discharge of pus takes place. This pus may be yellow, or greenish, or red from hemorrhage, or brownish from disintegrated blood pigment. Usually the pus contains many large or small oil drops from disintegrated fat marrow. This oily pus is very characteristic. At this time if the bone can be removed and sawed through vertically, the marrow presents, not a diffuse suppuration, but a mottled appearance, partly red from injected or hemorrhagic marrow, partly red or yellow from unaltered marrow, and partly yellow or greenish from suppuration. The distribution of the different areas is very irregular, and probably is determined partly by the distribution of blood vessels and partly by the facility or difficulty of extension from one alveolar space to another.

At a still later stage the appearance of the marrow is still different. The yellow areas of suppuration persist, while other portions are red and injected, but the red color at this period is due to the formation of granulation tissue in many of the alveolar spaces. In some cases, one end of the shaft may present this mottled appearance, while the other end may appear normal, while between the two there may be a pink or red band of granulation tissue entirely closing the marrow canal and separating the infected from the normal area. If

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the destruction of the infected marrow has been complete and the cortical bone also has become entirely necrotic, the shaft may be converted into a more or less complete bony tube, filled with dirty granular detritus and pus, and, if the bone is spongy, the necrotic trabeculæ form a mesh or frame work of brownish sponge-like structure.

Cortex.—The appearance of the cortex also varies with the stage of the disease. If examined very early, the periosteum is thick and edematous, injected, and is easily stripped from the bone. The bone itself looks white and shining, and often shows minute red vascular points. At a somewhat later stage the periosteum may be entirely separated from the bone by a collection of pus, oftentimes over the greater portion of the shaft. The periosteum may appear as a very considerable fusiform, fluctuating swelling or sac, often of large diameter. On incising such a sac, the bone is seen smooth, white and often dull. In the stage when necrosis of the cortical bone is complete, the cortex appears dirty white, or brownish, or black, bare, and absolutely without luster. It may be broken into spicules of varying size, or may be perforated by sinuses, or may be worm eaten. The cortex in the early stages may be partly adherent to the periosteum, even when necrosis is marked. In the later stage the necrotic shaft may lie perfectly free in the periosteal shell or in some cases portions of it may be perfectly free, while other portions of it are united to the thick bony periosteal shell or involucrum by bony adhesions, and separation of the two may be difficult. Or, if the suppurative process has lasted for years, as often happens, only a few thin worm-eaten spicules of cortical bone are seen, lying in a cavity of the periosteal shell which is covered with unhealthy granulations.

Periosteum.—The gross appearance of the periosteum in the early stages has been mentioned above in connection with the cortex, i. e., at first it is thickened and in-

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jected, and usually at an early stage is elevated from the bone by an extensive subperiosteal abscess. A few weeks later the periosteum is several times thicker than normal, and the deep layers are more or less rigid from the formation of bony trabeculæ, at first very delicate, pinkish white and crackling under the touch like hoar-frost. This crackling can also be detected by pushing a needle through the granulations at the edge of a sinus, when the new periosteal shell can be felt and heard to crackle under the touch of a needle. This can be used as a gross method to determine the proper time to operate (cf. infra). As time goes on, this periosteal layer increases in thickness, and finally forms a shell of variable thickness about the cortical sequestrum. The thickness of such a shell may be very great and equals, or sometimes exceeds, the total thickness of the original shaft.

This periosteal bone forms a cylindrical shell about the sequestrum and is always perforated at one or several points by sinuses for the discharge of pus. The shell, as already said, may be closely adherent to portions of the sequestrum, or may be separated entirely from the necrotic portion of the shaft, although it may be adherent by bony growth to the living shaft or to the epiphysis at the upper and lower ends of the sequestrum. If such unaltered portions of the shaft closely connected with the periosteal shell do exist, they usually are divided from the necrotic shaft by transverse bands of dense scar tissue, or more commonly in the old cases by a transverse layer or plug of very dense scar tissue or bone which frequently entirely occludes the marrow canal. In such a case the necrotic shaft lies in a cavity or box of dense ivory-like cortical bone. Such a cavity usually is lined with a layer of dirty unhealthy granulations. If the sequestrum is removed from such a cavity it leaves a cavity of dense bone lined with granulations, which has practically no tendency to heal. These cases are seen in old and long-continued "bone abscesses."

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Soft Tissues.—Beside these changes in the bone, secondary changes in the soft tissues appear early. Even before perforation of the periosteum appears the adjacent muscles, subcutaneous tissues and skin show edema, redness and induration. If the periosteum is perforated an abscess, often very extensive, may appear in the soft tissues. Such an abscess may spontaneously perforate the skin at several points, forming permanent sinuses. The edges of such a sinus are lined with unhealthy granulations. Such sinuses may be very large. In long-continued cases the skin and subcutaneous tissue are thickened from formation of dense scar tissue, while edema and infection persist. In extreme cases an affected limb may for years be nearly twice normal size.

SYMPTOMS.

The disease usually begins with sudden local pain, usually quickly becoming severe, and generally of a throbbing character. This pain is usually referred to the shaft of some one of the long bones, commonly at one end near the epiphyseal line. The limb at this time often is not so sensitive on motion, but the pain is intense on percussing the bone, even very lightly, or on continued pressure. Usually at a very early period swelling of the soft parts about the bone appears, and this swelling soon shows pitting on pressure and marked redness. The adjacent joint frequently becomes tender, hot and swollen. This swelling at first more often is due to the edema of inflammation rather than to direct infection, for cultures of the joint fluid at this time often are sterile. Rise of temperature to 103 or 104 often accompanies the early pain, and frequently the pulse is greatly accelerated, 120 to 140 beats per minute. Evidence of constitutional disturbance and infectious absorption usually appears early. The tongue is dry, coated and tremulous, the face drawn and flushed. Delirium, often of a mild type, is a very common factor, and this delirium frequently persists for some weeks after drainage of the bone has been made. Abscess of

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the soft parts may give deep or superficial fluctuation. Sinuses may appear. The leucocyte count usually is very high.

Such a chain of symptoms would appear to present a fairly distinct clinical picture, and it would be difficult to overlook such a typical case. The diagnosis of early cases, however, quite contrary to some statements, may be very difficult. Even in severe cases, the pain for some days is not severe. Sometimes the patients complain of very moderate pain for several days before local symptoms are evident, and the pain at first frequently is referred to an adjacent joint in which no gross change can be made out. Sometimes swelling of an adjacent joint comes on so early as to call entire attention to the joint, and distract one's observation from the bone focus until later swelling and edema of soft parts, or abscess over the bone, give evidence of extreme bony destruction. These cases frequently for days are treated as articular rheumatism.

The infection may be so severe and the patient's mental condition so stupid that the pain is not noticed, so that the cases may be mistaken for typhoid fever; this, too, by very competent and well-trained men.

These difficulties, however, do not excuse many of the frequent failures to recognize the condition, which seem often to be due to a neglect to remember that osteomyelitis is a not uncommon disease in children and young adults.

DIAGNOSIS.

The diseases most frequently mistaken for osteomyelitis are early acute tuberculosis of joints, acute articular rheumatism, gonorrheal rheumatism and typhoid fever.

Tuberculosis of the joints practically always begins in the epiphysis of the long bones, while osteomyelitis almost always begins in the diaphysis. This distinction will clear up the diagnosis in many cases. It is said that occasionally osteomyelitis begins in the diaphysis, although I never have seen such a case. In such a case

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the very acute onset, the early extreme pain and the early appearance of constitutional symptoms should permit of a diagnosis. Moreover, in epiphyseal osteomyelitis, spontaneous separation of the epiphysis is said to be common.

Acute articular rheumatism, as a rule, affects more than one joint, although one joint may be especially involved. In osteomyelitis the great severity of the affection of one joint, with the usual early marked redness and edema of the soft parts, and the almost constant bone tenderness, usually allow early differentiation.

Gonorrheal rheumatism, of course, may affect one joint, and the early symptoms may be severe. The bony tenderness is wanting, and the history or presence of an antecedent gonorrhea can usually be determined. It may be possible to cultivate gonococci from the joint fluid. A monarticular "rheumatic" attack in children or young adults should always cause at least a consideration of acute osteomyelitis.

The pain and local symptoms, the high leucocyte count, as well as the very sudden onset and absence of the Widal reaction, usually allow a distinction between typhoid and acute osteomyelitis to be made.

Any extreme pain in bone, with or without swelling, should always lead to a consideration of acute osteomyelitis. Both swelling and abscess formation may be delayed for several days. In the chronic cases a persistent sinus connected with bone means necrosis of bone, and suggests osteomyelitis, tuberculosis, actinomycosis, or rarely epidermoid cancer.

CLASSIFICATION OF TREATMENT.

Based on pathologic conditions, the course of osteomyelitis may be divided into three different stages: The acute stage, i. e., the stage of infection, necrosis, suppuration and general intoxication; the subacute stage, which begins with the evacuation of the purulent exudate and the cessation of toxic absorption; and the chronic stage, marked by the formation of sequestrum,

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involucrum and sinuses. The indications for treatment for these three stages are quite different, and will be discussed separately.

TREATMENT OF THE ACUTE STAGE.

In the acute stage there is inflammation of marrow, and often a subperiosteal abscess, and abscess of the soft parts. The indications are the same as in any other acute suppuration, i. e., evacuation of the pus. This demands evacuation not only of the soft parts, but of the bone as well. Incision of the soft parts alone is not sufficient. For evacuation of bone, a good-sized trephine button, at least one-half inch in diameter, of cortical bone should be removed, and if pus escapes from the marrow the hole should be enlarged along the shaft with rongeur forceps and chisel as long as pus can be found in the marrow. In early cases, a layer of cortical bone one-half inch or more wide and two or three inches long may suffice. In advanced cases a lid of bone should be removed from the entire length of the shaft. One very important fact should be borne in mind. The integrity of the endosteum is essential for the vitality of the inner layer of the cortex. Hence do not curette out the marrow. Extensive and vigorous curettage of the marrow, as frequently is done, is sure to destroy whatever of the endosteum is left, and necrosis of at least the inner layers of cortical bone is sure to follow. Moreover, such destruction is not necessary. The communication of alveolar spaces is perfectly free, as can be seen by injecting dried bones; removal of a sufficient amount of cortical bone gives good drainage to the marrow, and the undestroyed endosteum may be sufficient to repair the defect, and, in rare cases, allows the injured bone to heal without sequestrum formation. (See Case I infra.)

If the disease has extended to the epiphysis, removal of the cortex of the epiphysis will drain the epiphysis. In some cases extension to and suppuration of the joint cavity may occur so early as to require opening and drainage of the joint at the primary operation, although

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usually the early swelling of the joint is due to secondary edema. In operating on the cases where the epiphysis is involved, it is desirable to interfere with the epiphyseal line as little as possible.

TREATMENT OF THE SUBACUTE STAGE.

After the acute process has subsided from spontaneous or artificial evacuation of the pus, there comes the subacute stage, with necrotic shaft and proliferation of the periosteum. The amount and location of necrotic bone may vary. At times only a longitudinal sliver of a portion or the entire thickness of the cortex may be necrotic. In such a case, removal of the sliver may expose a layer of granulation tissue, arising from the marrow. Such granulation tissue arises from the proliferating reticulum of the marrow and from the endosteum. Such tissue may grow up to the level of the removed cortical sliver, periosteum may grow in from the sides, and ultimately the bony defect may in this way be replaced and complete healing may occur. Such favorable cases are rare.

More often there is a necrosis of the entire circumference of the shaft throughout its entire length or a considerable portion of its length. Such an extensive necrosis must be entirely removed, or a permanent sequestrum enclosed by a shell of involucrum will persist indefinitely. The old surgical axiom was not to remove such sequestra until they were freely movable, which meant practically no removal until the formation of involucra in most cases.

THE CHIEF OBJECT OF THE PRESENT ARTICLE.

The chief object of this paper is to emphasize and illustrate the fact that by early removal of such sequestra at a secondary operation, and by approximation of the inner surface of the proliferating, partly ossified periosteum, a new shaft of periosteal bone will be produced with constant regularity, which forms a new bony shaft, joins the epiphyses, or whatever portion of sound shaft

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is left, occupies the position of the original shaft, heals without sequestra or sinuses, and practically produces a new shaft of approximately the same size as the original shaft, which by physical examination can not be distinguished from the original bone. In consideration of the painful disability which follows the older method of treatment, lasting sometimes for many years, the results of such an operation are remarkable, while the functional results are perfect.

DISCUSSION OF METHODS FOR THE REPAIR OF BONY DEFECTS.

To close defects left by the late removal of sequestra at a late period, always a difficult matter, many methods have been tried.

The chief methods which have been recommended for the closure of large bony defects have been Hamilton's sponge grafts, Schede's aseptic blood clot, Neuber's approximated skin flaps and Senn's decalcified bone plates. Hamilton[11] recommended that the bone defects be filled with sponge, and claimed that the sponge acted as a framework for the formation of new bone, and that ultimately the sponge was absorbed. In that paper he described the use of the sponge in one case of extensive bone defect, but the result was a failure. In the conclusions, however, he recommends the sponge, with some apparent hesitation, entirely on theoretical grounds. The histologic descriptions of the conditions found in attempted sponge grafting in lesions of the soft tissue are not at all conclusive of the correctness of the theory. Schede[12] recommended that stiff walled bone cavities be filled with aseptic blood clot, in order that organization of the clot might ultimately fill the bone defect with dense fibrous tissue. He closed the skin over the cavity

11. Hamilton, D. J.: On Sponge Grafting, Edin. Med. Jour., vol. xxvii, p. 385, 1881.

12. Schéde, M.: Ueber die Heilung unter dem feuchten Blutschorf, Dtsch. Med. Wochenschr., vol. xii, p. 389, 1886; also, Ueber die Heilung von Wunden unter dem feuchten Blutschorf., Vorhandl. der Dtsch. Gesellsch. f. Chirurgie, April, 1886, p. 62, Berlin.

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except at the apex and covered the cleft so formed with protective, in order to provide for complete filling of the cavity and to prevent drying of the clot. Outside of the protective came a heavy absorbent dressing to take up excess of blood. He claimed that failures were due to failure to disinfect the cavity completely, to failure to entirely fill the cavity with clot, to neglect to remove all sequestra, or to local recurrence of tuberculosis at the edges of the wound. Considering the great difficulty of obtaining complete asepsis in such a cavity as that present in advanced osteomyelitis, Schede's results were surprisingly good. I have had an opportunity to try Schede's method in but three cases. The results were total failures, because in each instance the clot became infected, ultimately broke down, and was disintegrated. Neuber got unsatisfactory results with this method.

Neuber[13] found difficulty in disinfecting the bone cavity and sinuses sufficiently to obtain aseptic healing of the blood clot, especially where the bony defect was a large one. He tried to obviate this difficulty by cleaning out the bone cavity, removing the "osteophytes" (apparently the involucrum) and turning in flaps of skin and soft tissue adjacent to the bony defect in such a way as to line the trough with skin. These flaps were held in place by nails, plaster, or by "invagination" stitches specially applied. After healing there is at first a trough lined with skin, but Neuber says that finally the soft tissue retracts and the dimple largely or entirely disappears.

Both of these methods depend on the formation of a scar derived from soft tissue, but do not take into account the reparative power of the bone periosteum, and in a measure must be considered to avoid the conditions rather than to cure them. Both methods undoubtedly

13. Neuber: Zur Behandlung starrwandigen Hohlenwunden, Arch. f. Klin. Chir., April, 1886, p. 62; also, Veränderungen decalc. Knochenrohren in Weichtheilswunden, Arch f. Klin. Chir., vol. xxv, Heft 1, p. 316, 1879.

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have under certain conditions given good results. Schede's blood clot seems more likely to succeed with small cavities, while Neuber's offers the best chance of successfully closing large ones.

Senn[14] recommended decalcified bone chips which had been rendered aseptic by soaking in an alcoholic solution of corrosive sublimate and by being dusted with iodoform before use. The success of the operation depended on complete sterilization of the cavity before the chips were packed in. Then coagulated blood was supposed to seal the chips together. Senn claimed by this operation to avoid the marked loss of blood which occurred in Schede's method, and also the great and unnecessary destruction of sound bone produced by Neuber's method. Essentially Senn's method is analogous to Schede's, except that he has a dense animal tissue to organize instead of an extensive blood clot. It is difficult to see what advantage the chips can have over the blood clot under these circumstances, and the operation, according to Senn's own account, is as much dependent on obtaining perfect asepsis as Schede's method. The difficulty or impossibility of obtaining such ideal asepsis in chronic osteomyelitis has been mentioned.

THE WORK OF OLLIER ON BONE REGENERATION.

The most scientific and valuable work was done by Ollier.[15] In this monumental work Ollier demonstrated by excellent experimental work the regenerative power of the periosteum and its ability to regenerate an entire bone. He also applied this regenerative power to resection and ablation of bone, both for tubercular and osteomyelitic bone lesions. He seems, however, to have been hampered by the fact that he was able to make no sharp distinction between tubercular and infectious lesions; by a failure to appreciate the reparative power

14. Senn: Healing of Aseptic Bone Cavities, Am. Jour. of Med. Sci., New Series, xcviii, p. 219, 1899.

15. Ollier: Regénération des Os, Paris, Victor Masson et Fils, 1867.

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of the endosteum, and by the fact that antiseptic surgery had not been developed. Hence, although his operations were done on scientific principles, he was unable to obtain results equal to those obtained with modern technic. Consequently his operations were performed only under special conditions to "check excessive suppuration and avoid pyemia," and were not deliberately undertaken as the natural sequence in the course of a well-understood series of pathologic changes. His work is, however, a remarkable example of accurate observation, close reasoning and logical deduction.

The earliest mention of operations undertaken on the principles laid down by Ollier in this country that are known to me will be found in the Medical and Surgical Reports of the Boston City Hospital.[16] The cases, however, were undertaken because of special indications in the individual cases, chiefly profuse suppuration and extreme necrosis, and the general principles underlying the operation seem not to have been recognized, nor was any attempt made to formulate any general operative procedure.

THE AUTHOR'S THEORY.

My own attention was called to conditions which exist in osteomyelitic bones while working on the pathology of bone lesions in the Sears Laboratory of the Harvard Medical School in 1895. From a study of a considerable number of cases of osteomyelitis it seemed likely that it might be possible to remove the necrotic shaft at an early period and to approximate the inner surface of the ossifying periosteum, with the hope that by adhesion of these approximated internal surfaces the peripheral growth of the periosteum would reproduce a shaft which would take on the function of the removed necrotic shaft. It seemed probable from anatomic and pathologic reasons that the time for removal is not during the very acute stage. At that time the

16. Cheever, D. W.: Reproduction of the Tibia, Med. and Surg. Reports, Boston City Hosp., First Series, 1870, p. 362.

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periosteum is thin and contractile, and it seemed likely that difficulties in manipulating the periosteum and perhaps inability to obtain careful or accurate approximation of the inner surfaces, as well as the difficulty of maintaining the alignment of a merely fibrous band, would make the mechanical manipulation impossible. Moreover, because of the intense infection present during the acute stage, it seemed that there would perhaps be more or less infection and destruction of the periosteum which would prevent adhesion, and might also interfere with the bone-forming function of the membrane. It seemed likely that a better time might be the one when acute suppuration and infection had ceased, and when the periosteal proliferation and ossification had advanced to such a stage as to make certain the bone-forming ability of the membrane, and to make it sufficiently rigid to allow of accurate manipulation, without, however, the ossification being so advanced as to produce a rigid, non-plastic bony tube. This idea was first publicly stated in a paper read before the Massachusetts Medical Society, June 7, 1898, although it had previously been taught in the class room for three years. The period when these conditions would exist was reckoned by examination of a number of pathologic specimens to be about the eighth to the tenth week, and this time was later confirmed by examination of tissue from cases convalescent from acute attacks. The credit for the first operation based on this theory is due to Dr. Hayward W. Cushing[17] of Boston. The case was a complete success, and since then the operation has been performed at the Boston City Hospital on a number of cases, by various surgeons, with uniformly good results.

The early operations were done on diseased tibiæ. In such cases the fibula acts as a splint, maintains the length and, to some extent, the contour of the leg. It was found

17. Cushing: Annals of Surgery, October, 1899.

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later that the problem was a different one in disease, e. g., of the humerus. In such a case there is no accessory bone to act as a splint, and the danger was that if the dead shaft were removed before the periosteum was sufficiently rigid to bear weight or maintain contour, that muscular contraction and the impossibility of maintaining immobility might lead to great deformity of the limb. But it was believed that the earliest stages of the vascular and partly ossified involucrum might in contrast with the late, dense walled involucrum, have a power of growth centrally as well as peripherally, and two very successful cases have shown the correctness of that idea. So that the operation in the subacute stage can be divided into two classes, (1) those cases where an accessory bone is present to act as a splint, and (2) those cases where but one bone is present.

OPERATION WITH ACCESSORY SPLINT BONE.

The operation is indicated in those cases where there has been an extensive destruction of the entire diameter of a diaphysis over a greater or less length. If such a necrotic shaft is not removed it will persist as a sequestrum indefinitely, periosteal involucrum will form, and if the sequestrum is removed late, a box of dense bone will be left lined with granulation tissue, which usually will not close spontaneously.

The time for operation is the stage when periosteum has begun well-marked ossification in its deeper layers, and yet ossification is not so far advanced as to form a rigid periosteal shell. This time varies somewhat in different cases, but careful observation of a number of the cases shows that the average time for this condition to occur is about the eighth week after the acute infection has been stopped by spontaneous, or, better, by operative evacuation of the pus. The presence of well-marked ossification can be accurately determined by removal and examination of small bits of the periosteum from the edge of a sinus, being sure that periosteum is removed, and not merely a layer of granulation tissue de-

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rived from the soft parts. By microscopic examination the amount of formation of periosteal trabeculæ can be determined. The layer of bone formation should be about one-sixteenth of an inch in thickness. In a rough way the presence of this bony layer can be determined by thrusting a needle through the periosteum at the edge of a sinus. If new periosteal bone has been formed, the needle passes through soft tissue, then through a crackling, thin layer of delicate bone, and brings up against the dense shell of the necrotic shaft. When this thin, crackling, periosteal layer is felt, the periosteum is at the best stage for performance of the operation. At this stage an *x*-ray photograph may show some hazy thickening outside of the necrotic original cortex, but, as a rule, *x*-ray examination is much less satisfactory than the other two methods mentioned.

The extent of the operation, too, depends on the portion of the shaft which has been destroyed. In severe cases practically the entire diaphysis is destroyed. In such a case, removal of the entire diaphysis between both epiphyseal lines may be indicated. In other cases, especially where artificial drainage has been completed early, only a third or half of the shaft may be necrotic, while the rest of the shaft is viable and does not need to be removed. The amount to be removed can be determined by the condition of the periosteum, the amount of granulation tissue and pus between the periosteum and the old cortex, and by the condition of the marrow.

It may be taken as a working rule that such portions of the shaft as show no endosteal thickening or ossification, nor separation of periosteum, probably are viable. If at a given level the marrow shows no suppuration, but only moderate injection, it probably is safe to leave such portion of the shaft, and the limits of necessary resection are reached.

THE TECHNIC OF THIS METHOD.

The most favorable time for removal being decided on, an incision should be made through the soft parts and

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periosteum down to the necrotic bone, placing the incision along that part of the bone nearest the surface, and, when possible, including in the incision the sinus or sinuses persisting from the primary operation. By retracting the edges of the incision one can with a curved, flat, square-ended, periosteum elevator strip the periosteum from the necrotic shaft. Over the necrotic shaft the periosteum in places may be quite or entirely free. At times, however, the periosteum, usually over small areas, is quite closely adherent. Care should be taken not to puncture the periosteum at such points so that the periosteal tube to be formed may not be imperfect. As a rule, in front and laterally, removal of the periosteum is easily accomplished, but behind, e. g., along the posterior ridge of the tibia, removal may be difficult and require much care. If the shaft is movable at the affected epiphyseal line, one end of the shaft can be lifted by lion-jawed forceps, and the periosteum can be stripped downward from that point. Or sometimes the bone can be freed at the middle of the shaft, sawn across, and the stripping continued from that point toward each epiphysis.

In case the whole length of the shaft is not involved, one end usually can be easily detached from the epiphyseal line and the bone can be sawn, or cut through with a chisel, at that point of the shaft which is judged to be sound. If the bone is sawn through at a point where marrow seems infected, the shaft can be cut down still further by chisel or bone forceps until normal marrow is reached. In some cases, the marrow canal, as already stated, may be partly or wholly occluded by newly-formed scar tissue or dense endosteal bone. In such a case the shaft should be removed until the marrow is vascular and not infected, otherwise there is danger that the new shaft which will arise from the periosteum will not joint the dense old shaft and a pseudarthrosis might result. This precaution I believe to be very important.

After the removal of the shaft, entire or partial, the

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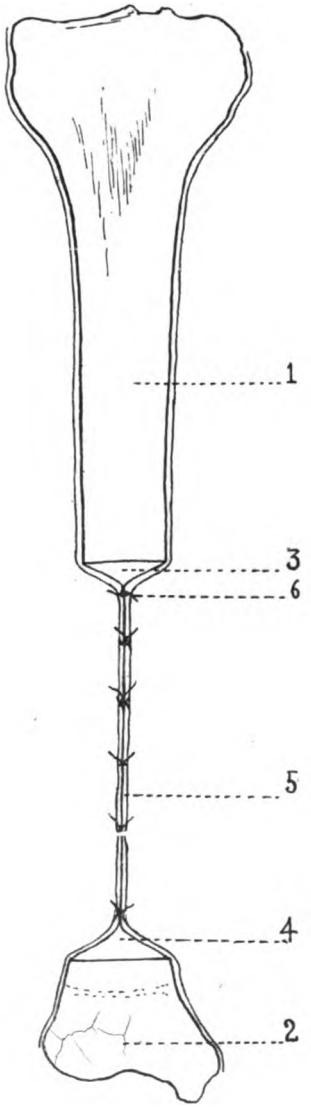

Figure 8.—Diagram to show relation of infolded periosteum in a case of complete removal of a portion of the tibia. 1. Upper portion of diaphysis of tibia cut squarely across. 2. Lower epiphysis and small portion of diaphysis. 3. Dead space between lower end of upper diaphysis and infolded periosteum. 4. Dead space. 5. Infolded and approximated periosteum. 6. Sutures.

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inner surface of the periosteum presents, extending from epiphysis to epiphysis or from epiphysis to normal shaft, as a wide band, usually pinkish white, with its surface studded with a thin white layer of bone. The membrane is plastic, not retractile, and crackles when folded. Sometimes small areas are lined with vascular granulations, and sometimes there is some purulent infiltration over areas which have been widely separated from the necrotic bone. It is desirable to disinfect the infiltrated areas as much as possible before folding the inner surface of the periosteum together. I have found 95 per cent. carbolic acid for two or three minutes, followed by swabbing out and washing with alcohol, useful.

After the removal of the shaft and disinfection of the tissues, the periosteum should be folded together in such a way as to make a flattened ribbon or tube of periosteum, approximating inner surface to inner surface, and leaving external surface still external. In this way the folded surfaces can adhere to each other, while peripheral periosteal growth can take place to form the new shaft. The edges of the ribbon should be fastened together by some sort of absorbable suture, preferably fine chromic catgut. Plain catgut does not, as a rule, persist long enough. The edges of sinuses in soft tissues should be curetted and trimmed and then the skin, and perhaps muscle, incision should also be closed by animal sutures. Sterile gauze and a plaster bandage complete the dressing.

It is to be remembered in approximating the periosteum that it is attached at either end of the ribbon to epiphysis or shaft. The epiphysis, of course, is, as a rule, wider than the shaft. Hence on infolding the periosteum there always will be a more or less extensive triangular dead space, just below the epiphysis, where the internal surfaces of the periosteum can not be completely approximated. Such an area finally will be filled with bone arising by central growth of bone from periosteum and epiphysis, but this growth is completed later

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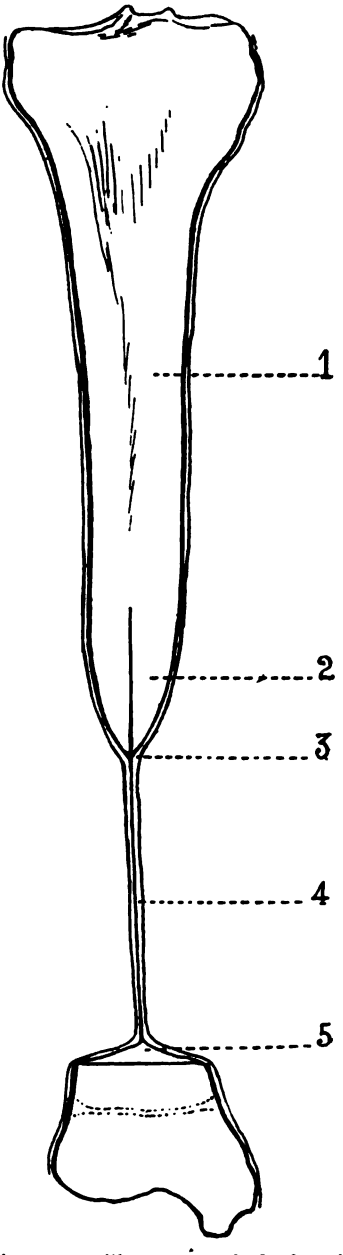

Figure 9.—Diagram to illustrate method of avoiding dead space in case of partial removal of e. g., shaft of tibia. 1. Upper portion of shaft of tibia. 2. Lower end of shaft chiseled into conical shape. 3. Close approximation of periosteum to conical end of shaft, obliterating upper dead space (See Fig. 8, No. 3). 4. Approximated periosteum, after removal of portion of shaft. 5. Dead space just about epiphysis, as epiphysis can not be made conical without interfering with epiphyseal line.

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than the regeneration of the shaft, remains yielding quite late and frequently shows some evidence of necrosis long after the rest of the regeneration is completed. A very minor operation on such an area, i. e., dilatation of a sinus and curetting, may be necessary before such an area will completely heal.

If a portion of the shaft is left at the time of the resection and the sound end is cut off square at right angles to the shaft, the same triangular dead space may persist, but in such a case if the end of the old shaft is tapered off by chisel and forceps, the bone may be so pointed as to allow complete approximation of the periosteum. Such an expedient can not, however, be safely adopted with the epiphysis and yet allow the preservation of the epiphyseal line.

AFTER-TREATMENT.

Certain precautions and difficulties in the operation and after-treatment should be considered. Of course, some infection and suppuration will be present when the operation is done, but they should be minimized as far as possible. For this purpose free incisions, followed by careful daily dressing and irrigation, should be provided for some time before removal of the shaft when necessary. Often the reaction to the inflammatory process in the soft tissues and periosteum leads to the formation of an enormous amount of vascular granulation tissue in the soft parts about the bone. Incision of such parts may lead to a very great oozing hemorrhage during the operation, sufficient at times to make the operation dangerous from loss of blood. This may be avoided by the application of an Esmarch bandage before the operation and removal after the dressing. I have known of two cases where the hemorrhage was so severe as to require that the operation be done in two steps; at the first step periosteum was partly peeled back from the bone and the operation completed some days later after hemorrhage had ceased.

In regard to closing the wound, it is to be remem-

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bered that the operation practically never can be done on perfectly aseptic tissues. Some suppuration may take place between the approximated surfaces of periosteum, and some is sure to take place between the soft tissue edges. Consequently it is advisable to leave the stitches in the periosteum as far apart as is possible with accurate approximation of the edges. The edges of the soft tissue may be closely approximated, but provision for drainage should be made by very small gauze wicks or catgut drains.

The operation produces usually moderate depression, not so severe as an amputation. In spite of all precautions there is apt to be some evidence of septic absorption, coming usually on the second or third day, but usually disappearing within a week. In two cases the post-operative infection was sufficient to cause mild delirium for a week.

The wound may heal by first intention over the greater portion, but some redness and slight sloughing of the edges usually appear. In one case this sloughing was sufficient to cause considerable gaping both of soft tissue and periosteum. Sinuses often develop for a time, but have always ultimately disappeared. They usually appear near the epiphysis, or at the junction of periosteum and shaft. As has been said, sometimes a slight amount of curetting may be necessary before permanent closure takes place. It is desirable to prevent backing up of infection because of the danger of infection of the epiphysis and ultimate infection of the joint as happened in one case (Case 5, cf. infra).

The first dressing should be done usually by the third day; a wet dressing may be necessary for the first ten days. After that time, dressing should be done sufficiently often to absorb any discharge.

Marked induration along the line of the bone usually is felt by the third week. From that time on the bone gradually increases in density and size. The new shaft at first and for some months has no marrow canal, but is

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composed entirely of trabeculæ of periosteal bone with myxomatous granulation tissue, instead of fat marrow. The new shaft grows to be larger than the original shaft during the early months, but in time decreases in size and practically comes to the size of the corresponding shaft. In course of time a marrow canal appears in the new bone, to judge from the *x*-ray pictures. I never have had a chance to examine such bones at autopsy. As a rule, the new shaft is a trifle more irregular than the original shaft. The shaft is strong enough to allow free use after from five to eight months. Even when the entire diaphysis has been removed, if the epiphyseal line has not been interfered with, no shortening of the limb need result, and that, too, in young adults of fourteen years. As far as function and use go, the results often are absolutely perfect. Even in cases where the epiphysis is interfered with, the shortening may be slight and the function perfect.

OPERATIONS WHEN NO ACCESSORY SPLINT BONE IS PRESENT.

The above operation is particularly applicable to bones like the tibia and fibula, or the bones of the forearm. In cases where there is only one bone in a limb, e. g., the humerus, the danger of deformity from muscular contracture must be considerable if the necrotic shaft is removed before the periosteum is rigid. But, as has already been said, if the periosteal shell is allowed to become too rigid and dense, it has very little or no power of repair centrally. The triangular space, however, between epiphyseal line and approximated periosteum showed, in some of the operations on the tibia, some power of growth centrally, so it was believed that the periosteal shell, if the necrotic shaft were removed from the box of involucrum early enough, might have sufficient power of central growth to repair an extensive central defect. Naturally the time when such a power would be greatest would be when the shell was as young as possible, i. e., just as soon as the shell was sufficiently

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hard to bear weight or maintain the contour of the limb. This assumption has been found to be true. The difficulty of telling just when this time has arrived is considerable. The *x*-ray furnishes the best means of determination, and the relative apparent increase in the size of the shaft due to formation of involucrum tested by palpation also is of assistance. With sufficient fixation, new periosteal bone whose diameter is equal to one-half the diameter of normal shaft is sufficient.

POINTS IN THE TECHNIC.

Hence in such cases the secondary operation must be undertaken at a somewhat later time than the secondary operation in cases where an accessory splint bone is present. In the two cases where there has been opportunity to try the operation, the time was judged to be sixteen weeks. The operation requires an incision through soft parts down to periosteal shell. Then with chisel and gouge a longitudinal opening must be made through the periosteal shell long enough to reach the lower end of the necrotic shaft, unless, from the early drainage operation, a gap has been left in the periosteum. If sufficient opening through the periosteum is made at the primary operation, but little will need to be done at the secondary operation. The opening must be approximately one-half an inch or more wide. Then the necrotic shaft must be grasped by bone forceps and by a rocking motion, without too much lateral force, be freed from the periosteal shell. Then it can be crushed by pressure of forceps, and withdrawn piecemeal through the opening. Separation of the fragment at the epiphyseal end, as a rule, should be easy. If the shaft is firmly adherent to the end of the original shaft, very careful chiseling may be necessary to free it. The cavity in the periosteal shell can be cleaned out with 95 per cent. carbolic, followed by alcohol. The skin incision should be closed by chromic gut sutures, except for a small opening for a small gauze drain. Fixation must be continued for some time until the bone has become suffi-

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ciently rigid not to be broken by muscular action or slight blows. Complete closure of such a cavity demands a longer time than usually is taken for regeneration of a tibia, apparently because power of growth of the vascular involucrum centrally is less than its power of peripheral growth.

This operation is essentially the removal of a sequestrum from an involucrum, but it is the removal of an adherent sequestrum at an early stage, from a young involucrum which can grow centrally, and not the removal of a movable sequestrum from an involucrum of dense bone which has no such power. The latter and older method leaves a bony box which does not repair the defect.

TREATMENT OF THE CHRONIC STAGE.

In this stage there exists usually an old necrotic shaft, usually worm-eaten, perforated by sinuses, and often freely movable, enclosed by a shell of dense, periosteal bone like the cortex of normal bone. Moreover, the ends of the sequestrum often are separated from the epiphyseal line and from the sound portion of the diaphysis by a layer of very dense bone which has arisen from the endosteum, and has completely occluded the marrow canal. This endosteal plug also is composed of dense bone like cortical bone; that is, the sequestrum lies in a complete box of endosteal and periosteal bone which has no power of central growth. Removal of the sequestrum may give drainage, but the defect fails to heal. Such a cavity usually is lined with dirty granulation tissue from which a constant discharge takes place. If the granulations are removed, the wall is seen to be dense white bone. Such a cavity may persist for many years; in one case seen by the writer it persisted for forty years.

Ollier showed by experiment on animals that normal periosteum was capable of regenerating an excised shaft of normal bone. Case 2, mentioned below, shows that, in the human subject, the periosteum at times is capable of regenerating a shaft removed during the acute stage

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of osteomyelitis. It seems possible that advantage of this regenerative power of the periosteum might be taken in cases of chronic osteomyelitis with a box of dense periosteal and endosteal bone. In chronic cases outside of the periosteal involucrum is a layer of approximately normal, although usually somewhat thickened, periosteum, which can be stripped from the outer surface of the involucrum. If the sequestrum and involucrum together are then removed, the inner surface of the periosteum then can be folded and approximated as in the operation during the subacute stage, with an excellent prospect of regeneration. It is to be borne in mind that, in these cases, when the entire shaft is not involved the medullary canal for some distance above and below the sequestrum undoubtedly is occluded by dense endosteal bone, of limited power of growth. Consequently it will be essential to chisel through this sclerotic bone until fairly normal vascular bone marrow is reached, otherwise there is danger either of great delay in union, or of failure of the regenerated periosteum to join the sclerotic ends of the shaft. In the only case in which I have had an opportunity to try this operation, in a somewhat modified form (see Case 12), the regeneration of bone was sufficiently complete to give a useful leg, although, probably for special reasons, a small sinus still persists. I believe that the prospects of complete cures in such cases are good enough to justify other attempts at the operation.

ILLUSTRATIVE CASES.

The following clinical cases are presented to illustrate the feasibility of the operation, the constant periosteal regeneration and the excellent results which can be obtained. Where the cases were not my own, the name of the surgeon who operated has been given. My thanks are due to my colleagues on the staff of the Boston City Hospital for permission to present such cases:

CASE 1.—W. J. D., boy, 4 years old. Case of Dr. J. C. Munro. Admitted to the hospital Aug. 5, 1902. Seventeen

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days before entrance fell while playing and bruised thigh. No known focus of infection. No symptoms for eleven days. Then sudden pain, soon followed by swelling of left thigh just above the knee joint. Pain and swelling increased, and some effusion appeared in the knee joint, which was flexed to within ten degrees of a right angle. Temperature 100.5, pulse 120.

Operation.—An incision three inches long was made on the

Figure 10.

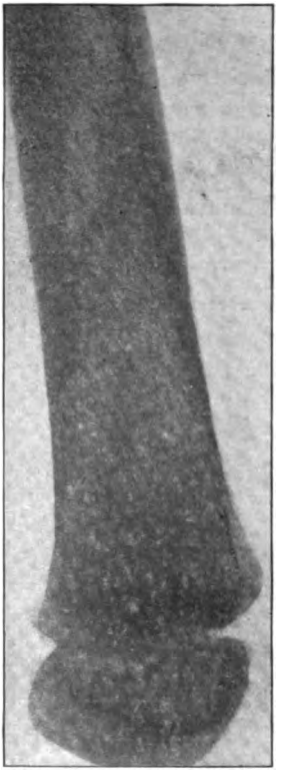

Figure 11.

Figure 10.— Case 1. Shows attitude, without atrophy or shortening. Scar of operation, inner side left thigh. Eight months after operation.

Figure 11.—Case 1. X-ray, left femur, side view. Slight change of density of bone, probably at upper limit of trephine hole in cortical bone. Eight months after operation.

anterior surface of the femur through skin and quadriceps muscle, with the lower end just above the upper limit of the capsule of the knee joint. The periosteum bulged, and when

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incised two or three ounces of thin yellowish pus escaped. The periosteum was stripped from the femur for a vertical distance of three inches, and apparently over the entire circumference. Shaft of femur was white and bare. Opening made through femoral cortex into medullary cavity gave vent to about one ounce of thin, oily pus. The opening was continued downward to the upper epiphyseal line of the femur, and extended upward to make an opening three-quarters of an inch wide and three inches long. The medulla was not curetted or disturbed. Wound irrigated and closed about one-half by stitches at upper and lower ends. Wet dressing. Ham splint.

Results.—Immediate improvement in general condition. Local swelling rapidly subsided, and effusion into joint disappeared. Wound healed fairly quickly by granulation. The patient was discharged seventeen days after operation with a superficial granulating sinus, wearing a ham splint. The sinus was completely healed within three weeks after discharge and has continued so ever since. Culture taken at time of operation showed *Staphylococcus pyogenes aureus* in pure culture.

Examined April 2, 1903. Well-developed child, walks and runs without any limp. Over anterior surface of thigh a rather broad linear scar, not adherent to bone underneath. No shortening or atrophy of left leg or thigh. No tenderness. On palpation no thickening of femur can be made out. Motions at knee joint normal. Child has had no symptoms for months.

This case shows that in cases seen sufficiently early, before destruction of the marrow is too advanced, removal of cortical bone alone, without disturbing the endosteum, will give sufficient drainage to the bone, and, in some cases, will allow complete restitution of the bone without formation of a sequestrum. It also shows that the effusion seen early in many of these cases is not due to infection of the knee joint, but is a manifestation of inflammation only.

CASE 2.—A. S., boy, 4 years old. Case of Dr. F. B. Lund. Admitted June 15, 1899. Three days previous to entrance fell and bruised his left leg, without breaking the skin. The next day the leg was swollen, tender and painful, and the patient had a chill. There was no known focus of infection.

At entrance the left leg was swollen from knee to ankle, extremely painful, tender and edematous. Temperature 103.

Operation.—June 16, an incision was made along the crest of the tibia from the tibial tubercle to just above the ankle

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Figure 12.—Case 2. Left leg. *x*-ray, front view. Nine months after operation. Tibia regenerated except in lower fourth. Irregular outline of tibia probably due to difficulty of manipulating periosteum in acute stage. Eight months after operation.

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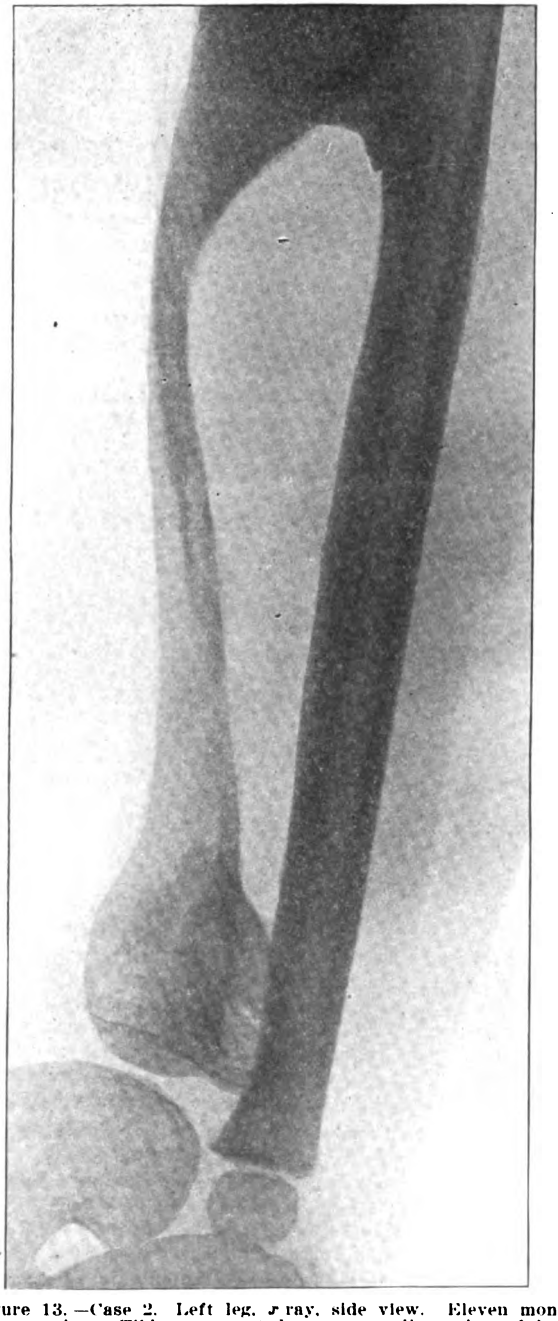

Figure 13.—Case 2. Left leg, x ray, side view. Eleven months after operation. Tibia regenerated except small portion of lower fourth. Antero-posterior bowing marked, probably because of difficulty of manipulating periosteum in acute stage.

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joint. Hemorrhage was profuse. The periosteum bulged into the wound, and when incised gave vent to several ounces of thin yellow pus, and showed that the periosteum was almost entirely stripped from the tibia. The shaft of the tibia was white and bare. The shaft was excised between the tibial tubercle above and the epiphyseal line below. The wound was partly closed by sutures, and a wet dressing and a posterior wire splint applied. There was immediate improvement in the general condition.

Results.—During the first few days there was considerable discharge of pus, with some sloughing of the edges of the wound. The wound in a few days became a clean granulating trough, which closed from the bottom. The leg showed some tendency to outward bowing. On July 15, twenty-nine days after the operation, there was a fairly firm tibia from the tibial tubercle half way down the leg, and the wound was entirely healed with no sinuses. Two weeks later, forty-three days after operation, the upper three-quarters of the tibia was solid, while the lower quarter was elastic. August 13, two months after operation, the bone was solid except at the upper and lower ends. There was a small sinus at the lower end of the incision, at the junction with the epiphysis, and this sinus was dilated and two small fragments of necrotic bone were curetted out. On October 16 the patient was discharged wearing a plaster bandage. He had been about in plaster with crutches for some time. There was no sinus, and the new shaft was solid except at the junction with the lower epiphysis, where there was a slight elasticity. Every endeavor has since been made to find this patient, but without success.

This case shows the capacity of the periosteum to regenerate new bone nearly completely, even when the necrotic shaft is removed during the acute stage of the disease. The *x*-ray photograph, however, shows that the periosteum at this stage is not so easily managed in the large long bones, at least, as it is during the subacute stage.

Case 3.—P. R., Italian laborer, 20 years old. Admitted Oct. 17, 1902. Speaks no English and history of illness is imperfect. Five or six days previous to admission received a blow over the collar bone. Five days later pain and swelling over sterno-clavicular articulation. Swelling, pain and redness rapidly increased. Over right sterno-clavicular articulation a red, painful, fluctuating swelling about two inches in diameter. All motion of the arm painful.

Operation.—October 20. An incision about three inches long was made along the inner end of the clavicle, starting from the outer margin of the sternum. An abscess of the soft

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tissue was opened, which discharged about an ounce of thick yellow pus. The periosteum was stripped completely from its attachment to the inner two inches of the clavicle, was thickened, injected, but showed no bone in the deep layers. The cartilage of the proximal end of the clavicle was loosened. The inner end of the clavicle itself was soft, friable and contained pus. The sterno-clavicular articulation of the clavicle was freed, and the periosteum reflected from the inner two inches of the bone, and the bone was sawn across, removing the inner two inches. The abscess was curetted and made as clean as possible, and the periosteum of the clavicle was folded together and the edges approximated with catgut sutures. Wet dressing and Velpeau's bandage were applied.

Histologic examination showed acute osteomyelitis. Culture showed *Staphylococcus pyogenes aureus* in pure culture.

Results.—Eight days after the operation a superficial ab-

Figure 14.—Case 3. Six months after operation. Linear scar over inner end right clavicle.

scess developed under the right arm. Otherwise convalescence was uninterrupted and patient was discharged fourteen days after the operation with a small granulating surface over the middle of the incision and no sinus. The patient began to use his arm six weeks after the operation, and has worked as a laborer ever since Dec. 1, 1902.

Examination April 3, 1903, shows well-developed man with wide linear scar three inches long over inner end of the clavicle, beginning just inside the outer margin of the sternum. The clavicle appears normal except over one inch of inner extremity. There it is about half as thick again as normal, and is somewhat irregular in outline, not tender on pressure. Motion with the sternum is as free as on the unoperated side. All motions of the arm are normal. There is no pain on motion. Patient uses pick and shovel daily, and says he "can

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do everything but fight." Violent blow of fist, suddenly checked, causes a little pain at sterno-clavicular articulation.

This case is reported to illustrate the reparative power of the periosteum in the acute stage of osteomyelitis. In this case the difficulties in manipulating the periosteum were not so great as in the preceding case, chiefly from anatomic reasons.

CASE 4.—J. W. D., male, 17, school boy. Four weeks previous to admission, without assignable cause, he was suddenly seized with intense pain about the right ankle. No known primary focus of infection. Swelling rapidly ensued and extended to the knee. There were repeated chills. An abscess opened spontaneously above outer side of right ankle after seven days, and one opened just below the knee three days later.

Admitted Dec. 16, 1898. Patient showed signs of septic absorption. Right leg was swollen from ankle to knee, red, edematous and painful. There was a large sinus over the external malleolus, and a smaller one just below the tibial tubercle. Immediate operation was performed.

An incision was made four inches long over the lower sinus, and a similar one over the upper one, and two counter ones over the muscles of the leg. The tibia was bare, stripped of periosteum. Trephine hole into marrow through upper incision showed no pus, but "granulation tissue" marrow. Ankle joint apparently infected. Wet dressing and plaster.

Twelve days after the operation the foot showed a tendency to eversion. Immediate improvement in general condition followed the operation. Forty days after the operation an abscess appeared on the outer side of the leg from which pus was evacuated.

Operation.—Feb. 25, 1899, ten weeks after the primary operation, the secondary operation was performed by the writer. An incision was made over the crest of the tibia from the tibial tubercle to the lower epiphyseal line, and was carried down to necrotic bone. The periosteum everywhere was thickened, in some places being one-eighth of an inch thick, and everywhere showed in its deep layers new periosteal bone formation, crackling under the knife. The thickened periosteum was reflected from the tibia throughout the entire length of the shaft, except at the posterior tibial ridge, and various pus pockets were cleaned out with the curette. This was done to get rid of suppuration between the necrotic shaft and periosteum. The operation was checked at this point and a wet dressing and posterior splint applied, in order to give drainage and a chance for the extensive suppuration to diminish before removal of the shaft and closure of the periosteum.

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Fourteen days later, the discharge and local infection having largely diminished, the periosteum was entirely reflected from the periosteum and the entire diaphysis of the tibia was removed, and the edges of the periosteum were approximated

Figure 15.—Case 4. Dark areas along scar of tibia and over ankle are not crusts, but are due to lack of cleanliness. (Notice toes of left foot.) Inside and behind internal malleolus is a small sinus.

by catgut sutures. A wet dressing and a wire splint were applied. Daily dressing. There was some sloughing of the skin wound, especially over the lower third, with some eversion of

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edges. The upper two-thirds closed by first intention. There was practically no pain after operation.

Results.—Twenty-three days after removal of the shaft there was distinct bony induration along the line of the tibial shaft, which soon showed as a cylindrical mass, and attained a size apparently, to palpation, as large as the original shaft. This mass constantly grew more solid, and the patient was discharged June 21, 1899, a little less than four months after removal of the shaft. At that time there was no sinus or discharge, and the tibia was solid, although somewhat springy over the lower third. Induration, apparently bony, could be felt the whole length of the tibia. The patient wore a light plaster and used crutches. He was directed to return to the out-patient department at regular intervals. He came but two times, then began to walk on the leg. After some weeks an abscess appeared over the outer side of the ankle, which opened spontaneously, but gave practically no pain. This abscess apparently originated at or just above the point of union of the new shaft and the epiphysis. Considerable inflammation and induration of the soft parts about the ankle followed, and the foot flexed at the ankle joint. Since then the patient has walked on the leg, much of the time without any support, but at times with the aid of crutches.

At present there is considerable atrophy of the leg, with a quite rigid ankle, and foot flexed at the ankle joint and somewhat inverted. There are two sinuses, one at the outer side of the ankle joint and one over the internal malleolus. The tibial shaft is apparently complete throughout its length, and is firm and rigid, but feels considerably smaller than the normal tibia. The transverse diameter seems about the same as that of the other tibia, but the entire circumference is apparently less. This seems to have been due to some separation of the sutured edges of the periosteum.

The case is a functional failure, although the regeneration of the shaft was a partial success. The cause of the failure was apparently the development of a slight necrosis at the epiphyseal line and in the epiphysis, which, as has been said, is common. On discharge from the hospital, the result promised to be perfect, and the present state of affairs probably could have been avoided had after-treatment been followed up. The patient did not return because for a long time he suffered no pain, and because he has, even under present conditions, a fairly good functional leg. The *x*-ray shows that the diaphysis is much smaller than that of the normal leg.

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This may be due to a partial failure of the periosteum to regenerate, or may be due to the fact that the periosteum regenerates sufficient bone for function, as already mentioned.

CASE 5.—D. A. (case of Dr. H. L. Burrell), 14 years old. School boy. Two weeks before entrance he bruised the calf of the left leg, without breaking the skin. After that time he had constantly increasing pain in leg, at first dull, later severe, and finally localized over the front of the leg, with onset of fever and stupor.

Admitted Oct. 21, 1899. Septic appearance and stupid.

Figure 16.—Case 5. Left leg, two months after admission, one month before secondary operation.

Temp. 101.8, pulse 120. Left knee and popliteal space red, hot, tender, edematous and swollen, and extending down over upper half of leg. Knee flexed almost to right ankle and swollen; patella floats.

Operation.—October 22. Multiple incisions about the knee and evacuation of a large amount of pus. Femur not involved. Incision over crest of tibia showed bone bare and periosteum elevated. Wet dressing. *Staphylococcus pyogenes aureus* present in pure culture.

Results.—Immediate general improvement. Profuse discharge of pus continued and shaft of tibia became brown and perforated.

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Three months after this operation secondary operation was performed. An incision was made along the crest of the tibia from the tibial tubercle to two and one-half inches above the internal malleolus. Periosteum retracted and separated and entire diaphysis removed. The trough of slightly ossified periosteum molded into position and closed with interrupted sutures. Skin wound also closed and covered with silver foil.

Figure 17.—Case 5. Three years after secondary operation. No shortening or atrophy. Linear scar over tibia.

Sterile dressing, posterior wire splint. Tourniquet removed after the dressing. The first dressing was done on the tenth day. Upper and lower ends of incision healed by first intention with clean granulations over middle third. Thirty-seven days after the operation the leg showed formation of new shaft. One month later the leg was firm except for two small

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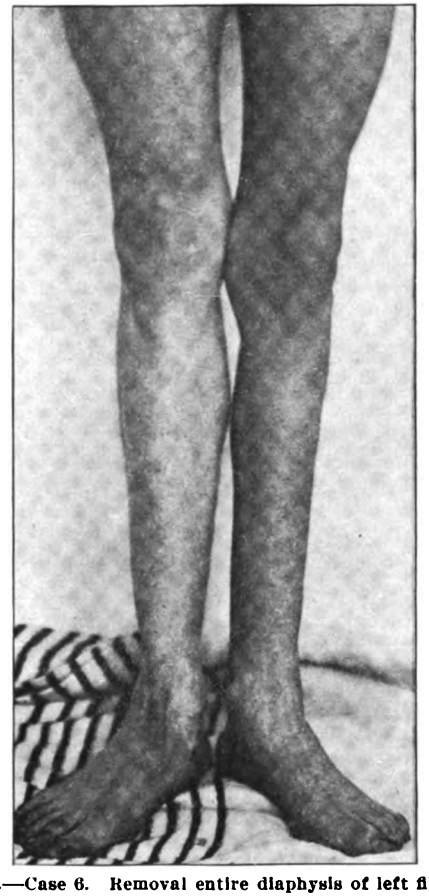
sinuses, one at junction of upper and one at junction of lower epiphysis with shaft. Parents refused to have sinuses curetted. On May 2, 1899, a little over three months after second operation, patient was discharged wearing a plaster, with crutches. The two sinuses still persisted, and there was slight mobility at the upper one.



Figue 18.—Case 6. Removal entire diaphysis of left fibula. Four years after secondary operation. Considerable atrophy, about one-half of an inch shortening.

The sinuses both closed in about four weeks, and the patient walked on the leg two months after leaving the hospital, and has done so ever since.

Examination in April, 1903, shows well-developed leg, no

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shortening or deformity or atrophy. A linear scar along the crest of the tibia. No sinus. No pain or subjective symptoms for two years. Tibia solid, of normal size, and by palpation is exactly like the sound one except for slight irregularity in contour. Perfect functional and cosmetic result.

This case shows practically perfect regeneration, after entire removal of diaphysis.

CASE 6.—F. N., patient of Dr. G. H. Monks, boy of 14. School boy. Seven weeks before entrance seized with pain in left ankle, at first dull, soon becoming intense and throbbing. The next day swelling of leg. On the third day an incision into the soft parts over external malleolus and evacuation of pus. This gave some relief until six days before entrance, when there was an exacerbation of symptoms.

Admitted Sept. 15, 1898. The leg was swollen, with tenderness chiefly at lower end of fibula. An ulcer presented over the external malleolus. Fibula was bare over lower five inches and a profuse discharge of pus. Wet dressing and fixation to clean up the region for operation.

Operation.—One month later the secondary operation was done. An incision was made the whole length of the fibula. The entire diaphysis was removed. Wound was packed with gauze and a wet dressing applied.

Results.—Immediate improvement in general condition. The wound closed by granulation. Two weeks later two small sinuses persisted. Two months and ten days after secondary operation patient went out wearing a plaster. Boy walked on the leg about six weeks after leaving the hospital, and has done so since.

Examination in April, 1903, shows somewhat atrophied leg, with linear scar along entire fibula region. Fibula can be felt, apparently complete and firm. Perfect functional result.

CASE 7.—H. S., 14 years old. School boy. Five days before admission spontaneous pain in right knee, very severe, so that he was unable to walk. Had chills and fever.

Admitted Sept. 14, 1900, for "typhoid fever." Stupor, mild delirium, leucocytes 8900, temp. 102.5. Three days later swelling of right leg from knee to ankle appeared and patient was transferred to the surgical ward. Leg swollen. Knee swollen and flexed. Cut six inches long over crest of tibia, beginning at tibial tubercle, evacuated much pus; periosteum bulging and tibia stripped. Trephine hole into tibia also evacuated pus from the bone. Opening enlarged downward three inches until no more pus escaped from the marrow. No attempt to close periosteal wound. Packed, wet dressing and plaster bandage. After operation, temp. 103, but normal on twelfth day. Wound closed by granulation, leaving bare bone

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at the bottom. Discharged November 13 with sinus, with direction to return for secondary operation.

Operation.—Feb. 7, 1901, he returned for the secondary operation. February 15 incision from tibial tubercle to junction of middle and lower third of leg. Upper third of tibia necrotic, periosteum thickened and crackling. Periosteum reflected from upper third of leg. Necrotic shaft removed from just below epiphyseal line to one inch below bottom of old trephine opening, until vascular marrow canal was reached.

Figure 19.—Case 7. Removal upper third right tibia. Incision over knee joint and linear scar over upper half of tibia. Four years after operation.

Upper end of lower fragment beveled off to allow approximation of lower fold of periosteum, but a triangular space had to be left between epiphyseal line and folded periosteum. Edges of periosteum united by interrupted chromic gut sutures. Skin wound closed with similar sutures. Dry dressing and plaster. First dressing in three days. Some sloughing of skin edges, approximated with adhesive plaster. Wound closed rapidly, mostly by first intention. Bony column first noted

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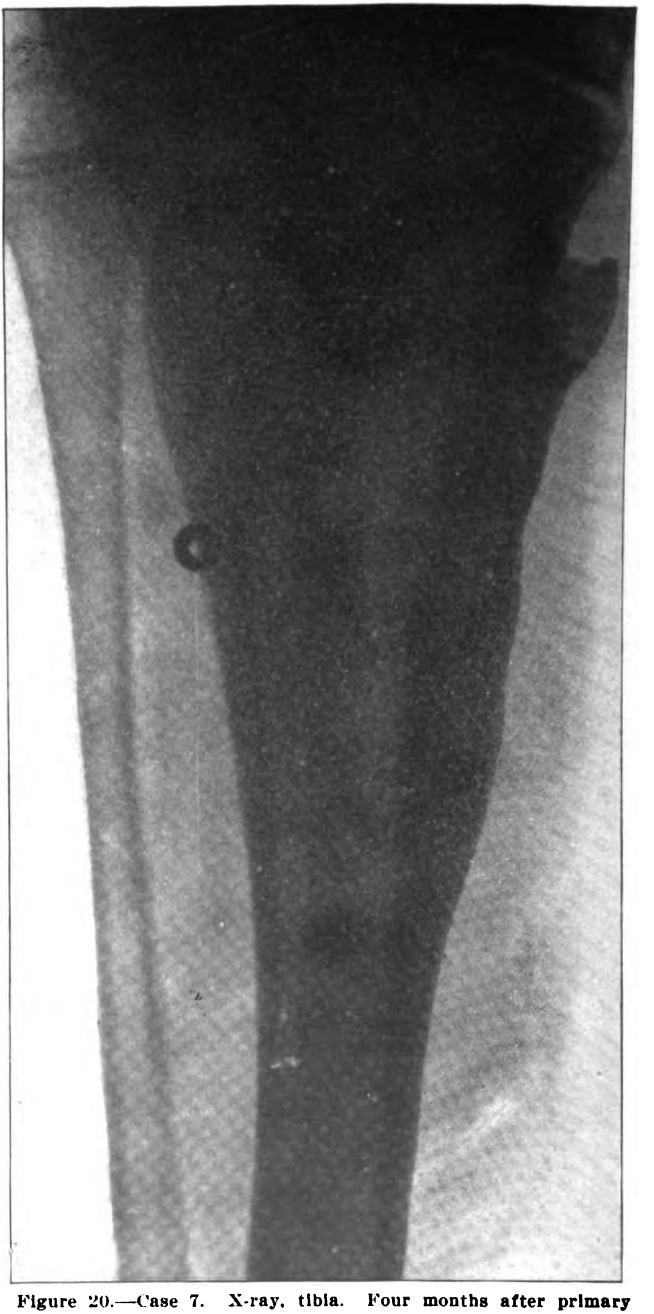

Figure 20.—Case 7. X-ray, tibia. Four months after primary drainage operation. Front view. Marked thickening from formation of periosteal bone.

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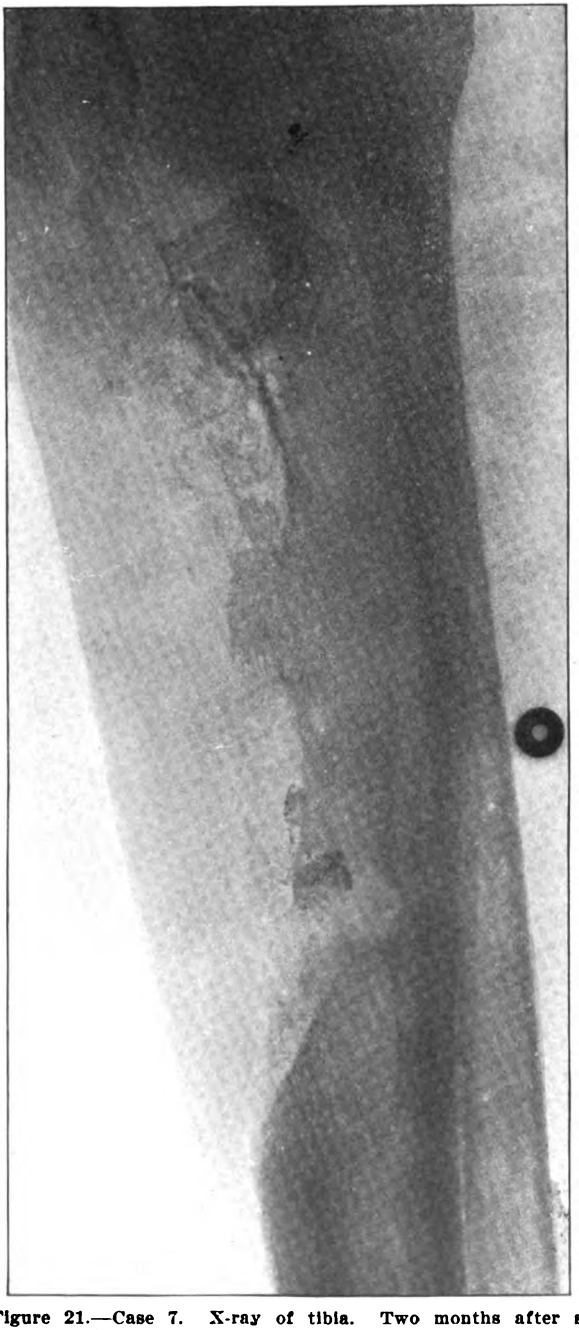

Figure 21.—Case 7. X-ray of tibia. Two months after secondary resection, upper portion of tibia. Side view. Regeneration of bone most marked posteriorly. Beveling of lower fragment is obvious.

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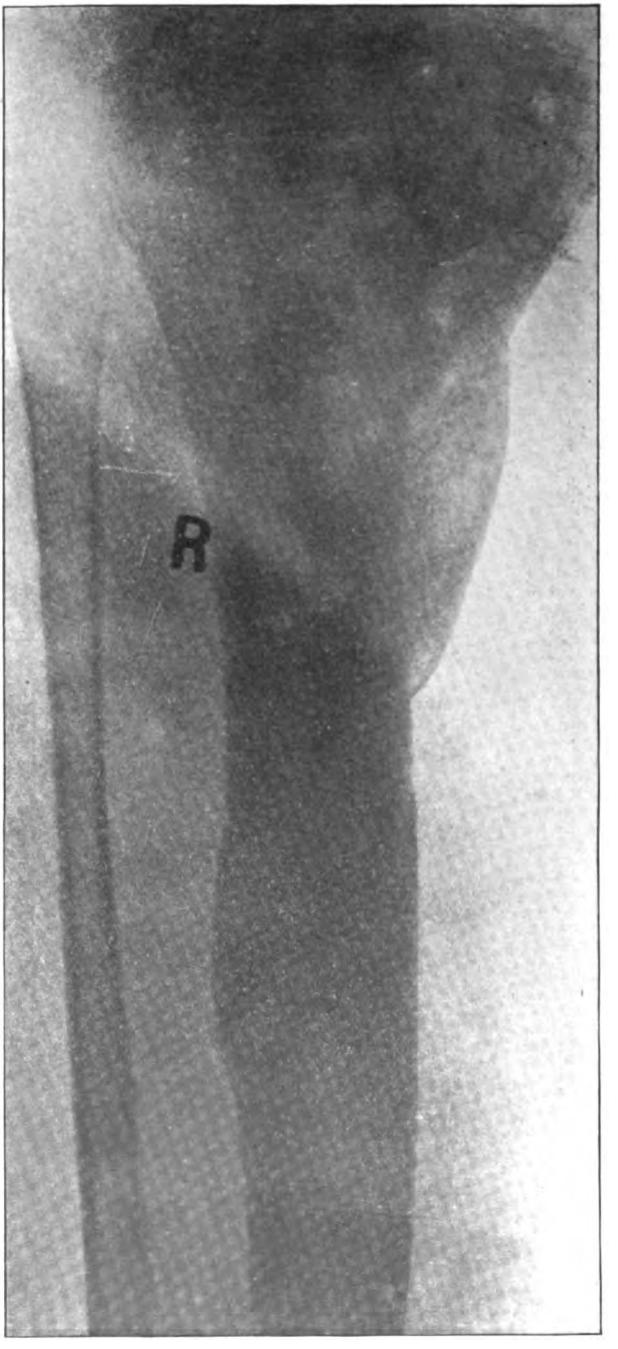

Figure 22.—Case 7. X-ray, tibia. Five months after secondary resection. Front view. Upper end of bone very wide (soft bone with overgrowth). Marrow canal not evident.

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on eighteenth day. On twentieth day patient fell out of bed and struck the leg, and soon after an abscess developed on the outer side of the leg, connected with the triangular space just below the epiphysis, and a little necrotic bone was curetted out. Ten days later another fall, knee swelled, and patient began to have chills, and two months after secondary operation knee joint was opened and purulent fluid removed. Knee was drained by gauze wicks. From that time patient continued to improve, knee joint closed, and on Feb. 23, 1901, patient was discharged wearing a plaster, with firm tibia and a small sinus just below epiphysis. The sinus closed in about four weeks.

Results.—The patient walked on the leg three months after leaving hospital, and has done so ever since, without any subjective symptoms.

Examination April 2, 1903, shows solid shaft of tibia without sinus, of practically normal size, possibly a little larger than the normal tibia and a little irregular in outline. No tenderness. Motions at knee joint perfect, except for a diminution of flexion by less than ten degrees. Scars of incision over tibia and into joint healed. Walks without limp. Perfect functional and cosmetic result.

This case shows the possibility of removal and regeneration of a necrotic portion of the shaft. It also illustrates the possibility of an infection of the knee joint by extension, and, furthermore, shows that the last place to heal usually is the interval just below the epiphyseal line.

Case 8.—R. L. T., female, 24 years old. Nurse. Twelve years previously sprained left ankle. Four years previously broke both bones of left leg, tibia just above the ankle and fibula at the middle. Six months after fracture had pain and swelling about left ankle and a small bit of bone was discharged through a spontaneous sinus. Sinus healed in two months. One year later another attack of pain, and a small spicule of dead bone removed by operation. From that time on had recurrent attacks of pain, often severe.

Admitted Oct. 24, 1900. Painful, tender swelling over lower third of left tibia with scar of old operation. Rest in bed and poultices. Radiagraph showed no bone focus, and patient went out with pain relieved on November 1. She was comfortable for a few weeks, when pain recurred.

She was readmitted June 23, 1901, with tender tibia and limited ankle motion. June 26, 1901, an incision was made by the surgeon then on duty and a trephine hole made above and below the epiphyseal line. From the upper trephine hole a thin pus escaped, and the lower one opened into a thin-

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walled bony cavity filled with pus. The cavities were packed and a wet dressing and plaster bandage applied. The wounds in soft tissue closed by granulation, but the discharge from the sinuses was profuse and great swelling of the soft parts ensued. Amputation was considered.

Figure 23.—Case 8. Removal, lower third, left tibia twice. Moderate atrophy left leg; some pigmentation of scar. No sinus.

Operation.—July 23, 1901, the writer operated. There was a sinus leading into a cavity in the lower end of the diaphysis, filled with pus and granulations. There was a similar sinus

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and cavity in the shaft of the tibia about four inches above the epiphyseal line. The two cavities did not connect. The cortex of the tibia between the two trephine holes was white, stripped of periosteum and necrotic, forming a fixed adherent sequestrum. The posterior portion of the cortex of the lower four inches was closely adherent to the periosteum. The

Figure 24.—Case 8. Removal, lower third, left tibia twice. Very slight antero-posterior bowing of left leg in lower third.

periosteum was thickened and showed moderate periosteal ossification. The shaft of the tibia was removed from the epiphyseal line to about an inch and a half above the upper sinus, except for a thin layer of cortical bone at the bottom. The marrow canal above the sinus was closed by rather dense

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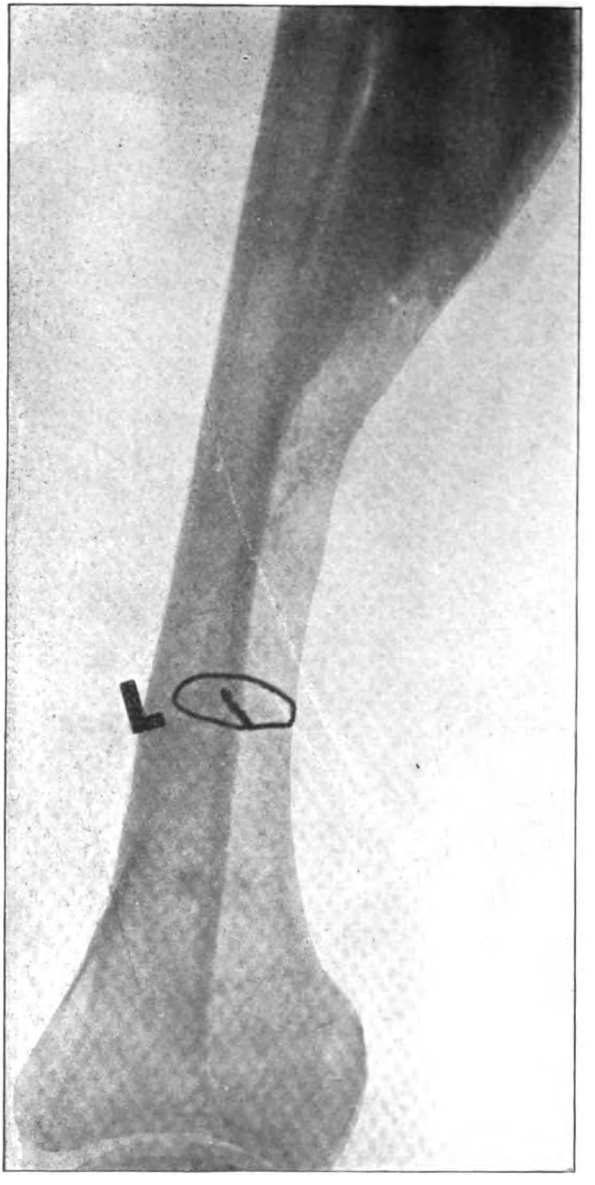

Figure 25.—Case 8. X-ray. Removal, lower third, left tibia twice. Six weeks after first removal of lower third of tibia. Shows tapering of upper end of tibia, silver wire suture and deep layer of cortical bone.

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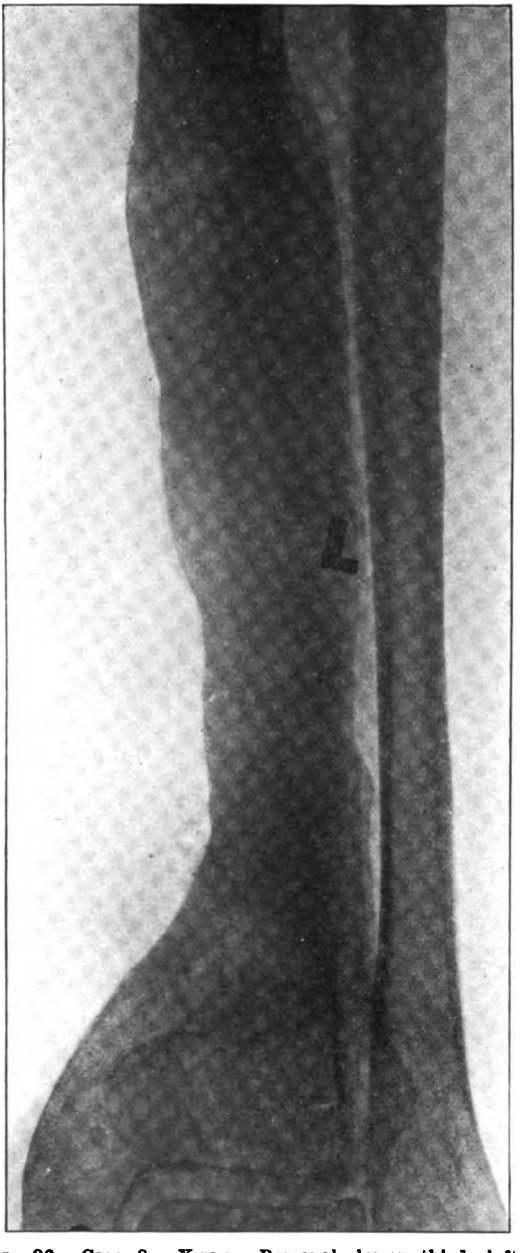

Figure 26.—Case 8. X-ray. Removal, lower third, left tibia twice. Front view. Six months after first removal of lower third of tibia.

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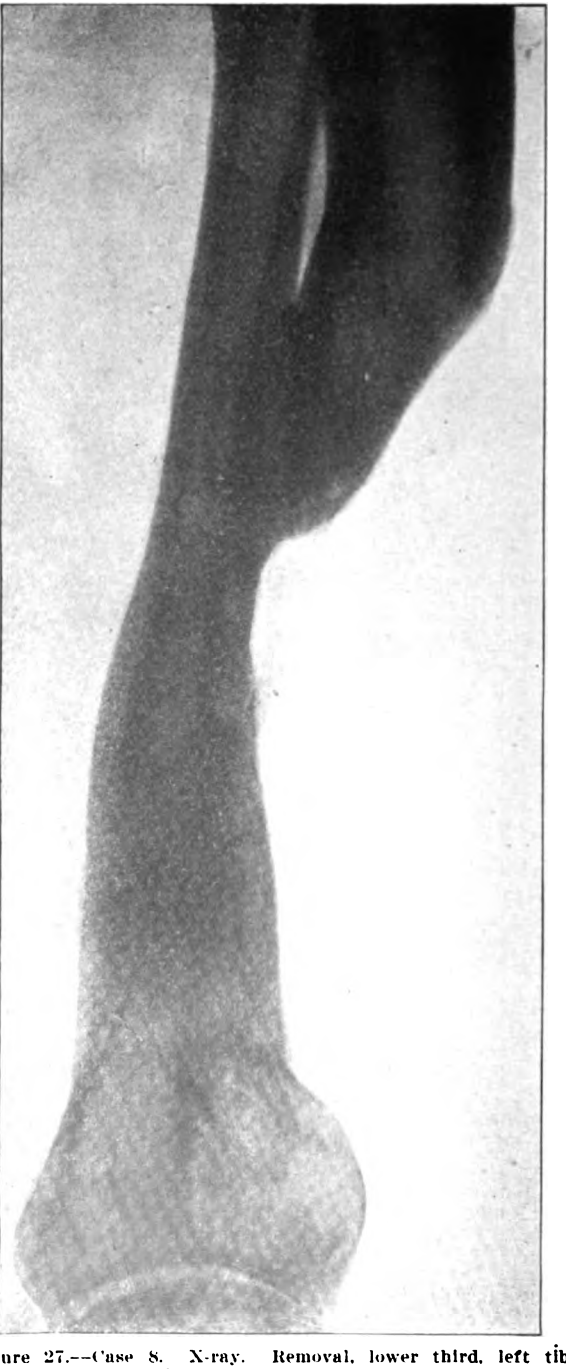

Figure 27.—Case 8. X-ray. Removal, lower third, left tibia twice. Lateral view. Nine months after first removal of bone.

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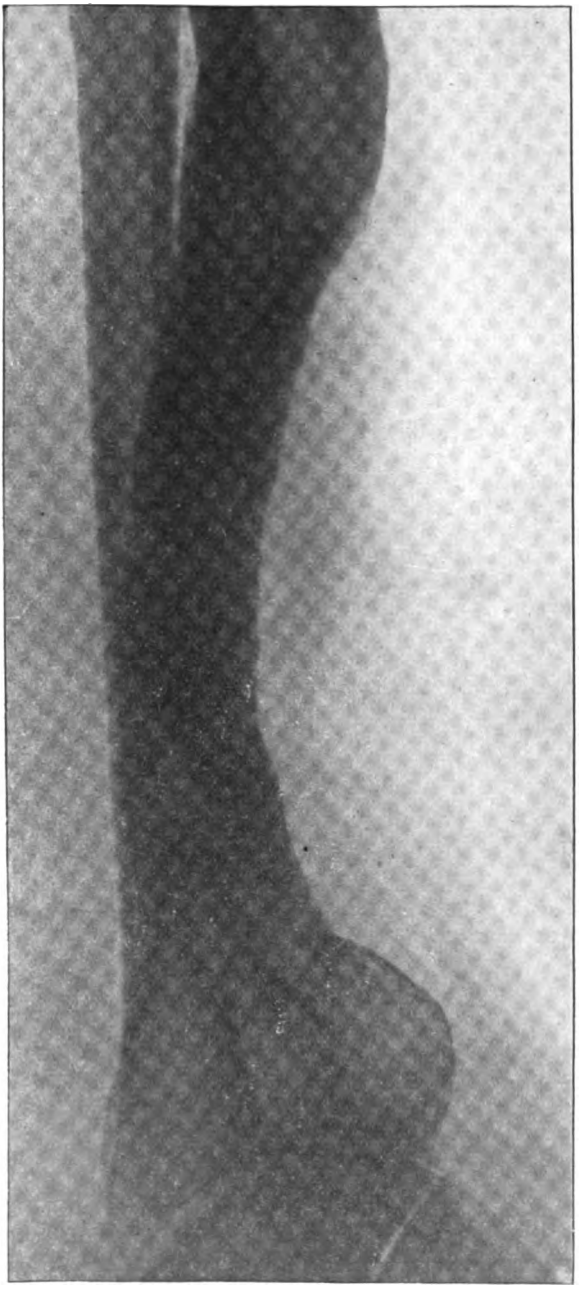

Figure 28.—Case 8. X-ray. Removal, lower third, left tibia twice. Lateral view. Nine months after second resection.

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scar bone, and the tibia was removed until the upper limits of this endosteal dense bone was reached, i. e., until vascular marrow was reached. A thin strip of cortical bone adherent to periosteum was left at the bottom of the cavity, because it was thought that this thin layer was viable on account of its attachment to the periosteum, and would serve to preserve the contour and length of the limb. This strip of periosteal bone was about one-eighth of an inch thick and one-half an inch wide. (See Fig. 30.)

All soft infected tissue was carefully curetted and the cavity was sterilized by 95 per cent. carbolic acid, followed by alcohol. The lower end of the upper fragment was beveled off to allow as accurate as possible apposition of the periosteum. The thickened crackling periosteum was approximated by three chromic gut and one silver wire sutures, which passed about the cortical remnant and outside the periosteum. There was a triangular dead space unavoidably left just above the epiphyseal line, and, of course, a similar smaller space just above the strip of cortical bone. The defect in the soft tissues was closed by sliding a skin flap across laterally and fastening it by interrupted gut sutures. A wet dressing and a plaster were applied.

There was some sloughing of the edges of the wound, and after about two weeks a sinus developed just above the epiphyseal line. The upper part of the wound closed by first intention. Suppuration from the sinus was profuse for three weeks. Two months after the operation a cylinder of fairly solid bone could be felt completely filling up the defect. Sinus had closed almost to level of the skin, and patient left the hospital Sept. 26, 1901, two months after operation, with plaster bandage and crutches. The sinus closed promptly, and the leg was comfortable for about two months. Then several small abscesses developed over the silver suture, which finally was removed in December, 1901. In January, 1902, the leg was completely healed and the patient walked without support. With the beginning of warm weather small abscesses again appeared, and on standing or walking the leg was painful. In July, 1902, a sinus developed and the patient came to the hospital. July 10, 1902, the sinus was curetted and found to extend outside the periosteum to a bit of apparently bare bone on the outer surface of the new shaft. This bare bone probably was some fragment of the cortical strip left behind at the operation. The wound closed slowly by granulation, but the discharge and pain continued and the leg swelled.

Aug. 7, 1902, an incision five inches long was made along the old scar. The periosteum was one-eighth of an inch thick. There was some suppuration of the surface of the newly-formed diaphysis. The periosteum was reflected. The new diaphysis

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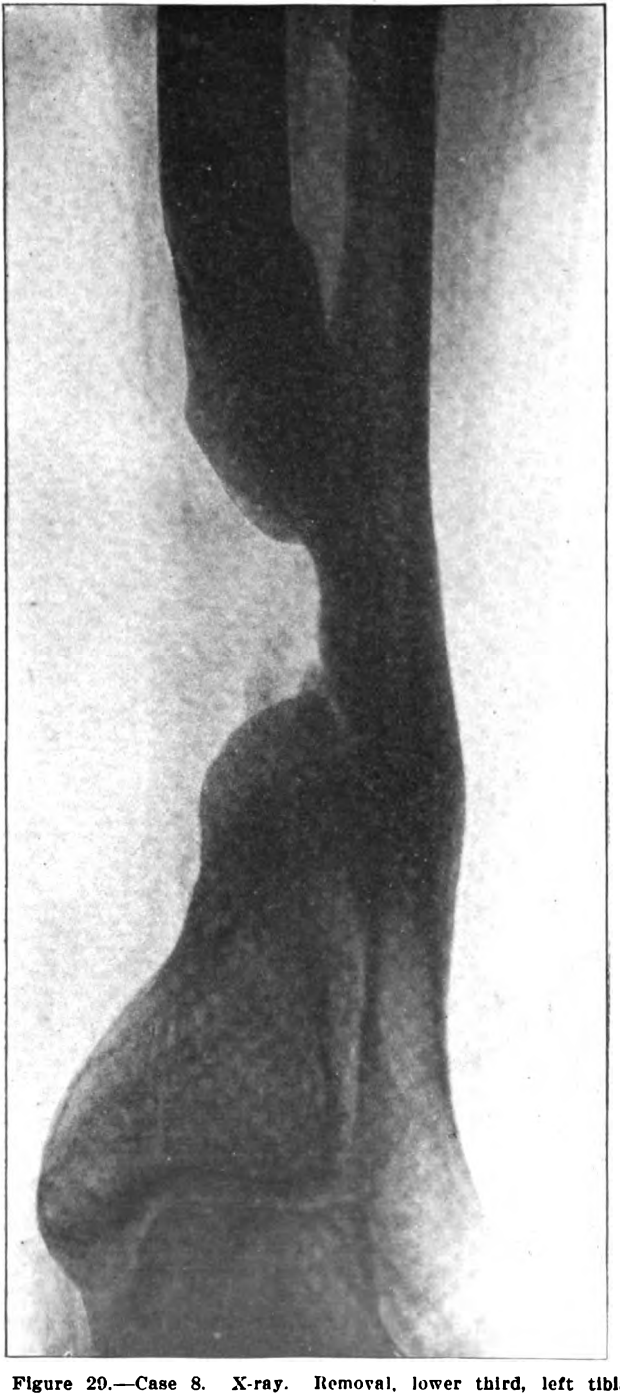

Figure 29.—Case 8. X-ray. Removal, lower third, left tibia twice. Front view. Nine months after second resection.

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was solid bone with no medullary canal. Fearing that there would be little power of repair of this dense bone, four inches, i. e., nearly all of the new solid diaphysis, were removed from just above the epiphyseal line up to vascular marrow. The periosteum was approximated by interrupted chromic gut sutures, and the wound of the soft tissues was closed. Wet dressing and plaster were applied. There was considerable pain for six days after the operation, referred to the external

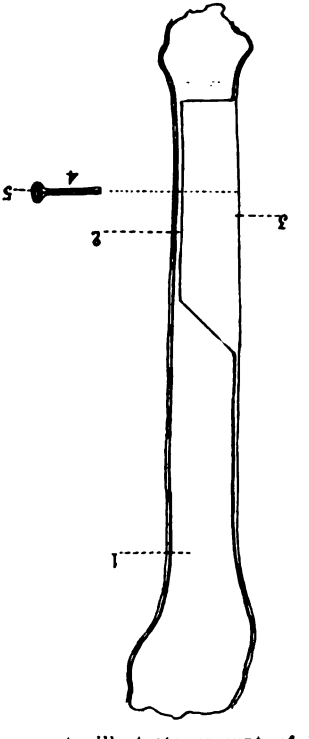

Figure 30.—Diagram to illustrate amount of bone removed in Case 8. 1. Upper portion of normal diaphysis. 2. Layer of cortical bone not removed at first resection. 3. Upper level of infolded periosteum. 4. Transverse section through infolded periosteum and posterior strip of cortical bone. 5. Posterior strip of cortical bone.

malleolus, the soft tissues over which were opened. Patient was mildly delirious for several days. There was almost no discharge from the wound in front of the tibia. Five days after the operation the patient was removed from the hospital, during my absence, against advice.

After leaving the hospital another abscess developed on the

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outside of the leg. This healed in three weeks. By Oct. 1, 1902, solid bone had appeared and sinuses were closed. In December patient walked with a cane. Since March, 1903, patient has walked without bandages or support.

Results.—Examination in April, 1903, showed patient walking without limp or pain. The leg is a trifle smaller than the sound one, and shows a little anteroposterior bowing in the lower third. The leg is one-half inch short. The scar is completely healed; there has been no sinus for six months. Tibia is solid throughout, width is a little greater than that of the normal tibia, but diameter on the whole seems a little less. There is, however, marked posterior bowing of tibia at the site of the operation.

The case is of particular value. At the first resection of the tibia I think it was a mistake to leave the posterior shell of cortical bone, as probably the persistent formation of abscesses was due to a failure of all of that shell to retain its vitality. The regeneration of bone by the periosteum, however, was complete, and, in fact, more perfect than it was after the second resection. The second resection was done practically on an unossified periosteum, and the regeneration has been fairly successful. The suppuration which followed, however, apparently caused some gaping and separation of the infolded periosteum, and explains, I think, the backward bowing of the new diaphysis. The case also illustrates the undesirability of unabsorbable metal sutures. The functional result is at present perfect, and the cosmetic effect nearly so. The case emphasizes the extraordinary regenerative power of the periosteum at any stage of the disease.

CASE 9.—J. P. R. School boy, 14 years old. Sixteen days before admission he bathed in very cold sea water. Three days later pain in left shoulder, soon becoming severe. Swelling appeared in a few days. Temperature became high and repeated chills. Admitted to the medical side as "articular rheumatism." Soon transferred to surgical. Temp. 103.4, pulse 124. Septic appearance and mental stupor. Left shoulder and upper arm much swollen, red, edematous and exceedingly tender and painful on motion or pressure.

May 12, 1900. Incision six inches long from tip of acromion to lower insertion of deltoid muscle. Subcutaneous tissue edematous. Deltoid fibers were separated and showed bulg-

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ing periosteum. Incision of periosteum evacuated several ounces of greenish pus. A one-half inch trephine hole through the cortex, just below upper epiphyseal line, gave vent to several drams of pus. Trephine hole enlarged down to the deltoid insertion until pus no longer escaped. Marrow was dark red and gelatinous. Marrow was not curetted nor disturbed. The wound was packed open with iodoform gauze and a big wet dressing and Velpeau bandage applied. *Staphylococcus pyogenes aureus* was present in pure culture. Immediate im-

Figure 31.—Case 9. Removal upper half diaphysis, left humerus. Three years after operation.

provement in general condition. Wound closed by granulation, but a sinus leading down to bare bone persisted. The patient was discharged two weeks after the operation, to come in later for secondary operation when periosteum had sufficiently thickened to maintain contour of limb.

Patient returned eighteen weeks after discharge, i. e., twenty weeks after the primary operation. Sinus meanwhile had been carefully kept open to allow of very free drainage. There was no limit to passive motion nor any pain. X-ray

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photograph showed much periosteal thickening outside the necrotic shaft.

Operation.—Sept. 28, 1900. An incision five inches long made through the old scar and sinus, beginning one inch below the tip of the acromion. The granulations of the sinus were curetted and the edges excised. The necrotic old shaft was lying in a cylindrical cavity of periosteal bone about one-half inch thick. The shaft was free at the upper end, but firmly attached below. The necrotic shaft was removed in two pieces with chisel and gouge and forceps, through the opening in the periosteal shell left over the old trephine holes, and was about three and a half inches long. The cavity had walls of vascular young periosteal bone. The cavity was packed with iodoform gauze. The shell was sufficiently rigid to maintain the contour of the limb.

The cavity closed rapidly from the first and by the end of two weeks was healed nearly to level of skin and no bare bone could be felt. Seventeen days after the operation the patient was discharged with a granulating wound, wearing an internal angular splint.

Three weeks later a small sinus developed at the bottom of the scar, and a small bit of bone was discharged. Ten weeks later a similar sinus occurred with discharge of a small bit of necrotic bone. The sinus did not completely heal for six months after the operation.

Results.—Examination in March, 1903. Arm has been completely healed for over a year. Wide linear incision extends from tip of acromion to the insertion of the deltoid, largely due to a separation of the deltoid fibers by the scar. The humerus is solid throughout, of apparently normal size, but a little more irregular than the normal humerus. Passive motion at the shoulder is unlimited. Voluntary motion is perfect except in elevation of arm from the side, due apparently not to loss of muscular power, but to separation of deltoid fibers. Functional and cosmetic effect nearly perfect.

The case illustrates the power of central growth of the earliest stage of the periosteal shell, in marked contrast to the lack of such power that is seen in old involucra, after conversion into ivory bone.

CASE 10.—G. Z., 18 years old. Brass finisher. One week before admission a pimple appeared on chin, below the tip. The next day marked swelling of face.

Admitted Oct. 8, 1900. Much swelling of left side of face and chin, with edema, swelling, redness and pain. No swelling in mouth and all teeth sound or filled on affected side. An incision of soft parts was made, evacuating about an ounce of pus. The edema and pain continued to increase, and a few

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days afterwards a second incision was made along the lower edge of the ramus of the jaw and a small piece of the internal shell of the ramus was removed. The boy was discharged eight days later with a discharging sinus leading down to necrotic alveolus, and urged to return for observation. After leaving the hospital all of the teeth except the last molar on that side became loose and came out, and a considerable piece of the alveolar process was removed through the mouth. The bone

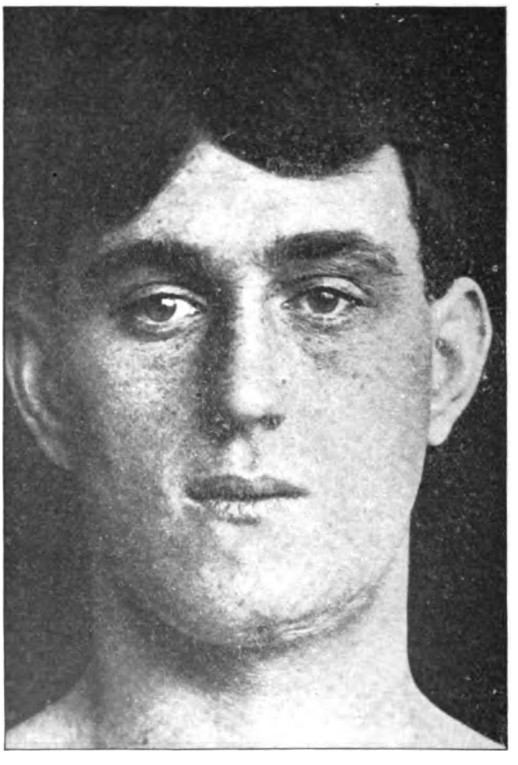

Figure 32.—Case 10. Front view. Thirty months after removal of two and one-half inches of ramus of left lower jaw. Contour of face has returned nearly to normal.

of the jaw of the left side rapidly increased to double normal size from formation of periosteal shell. Dead bone could be felt through sinus in mouth and through external sinus.

March 13, twenty weeks after primary operation, patient was readmitted. Jaw of left side nearly double normal size and causes marked deformity. The sinus below the left ramus

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persists. The thickening is almost entirely bony thickening, with but little edema of the soft parts. The jaw was at that time considered to be rigid enough to allow removal of necrotic ramus, and yet young enough to allow of probable central growth.

Operation.—An incision made from in front of the angle to nearly the tip. Periosteum was thickened to about one-quarter of an inch and quite rigid. A trephine hole, half an inch in diameter, was made near the tip of the jaw through the periosteal bone, and the opening was enlarged backward. Beneath the shell was necrotic ramus, surrounded by pus, and this was removed in one piece about two inches long, beside some smaller fragments. The cavity was curetted to remove all fragments of dead bone, and the cavity was closed except for a small wick in front. The wound closed by first intention except for the wick. The patient was discharged eight days later.

Results.—A month later a small abscess formed near the angle of the jaw, which apparently did not connect with dead bone, for it healed promptly after incision. The sinuses closed in about three months, and ten months after the operation the jaw was markedly reduced in size.

Examination April 15, 1903, shows the outline of the face nearly normal, as bony thickening of jaw has quite disappeared. Linear incisions along lower edge of ramus. Last molar on that side remains. All other teeth gone in lower jaw to first molar on opposite side. Ramus of normal thickness laterally, but not so thick vertically as normal, apparently because alveolar process did not regenerate. No sinus for a year and a half.

This case, like the preceding, shows the power of central growth of the early periosteal shell.

CASE 11.—C. C., Italian, housewife, 24 years old. Speaks no English and history is imperfect. When 14 years old bruised the leg. Shortly after the leg swelled, patient was very sick, and an abscess formed, which broke and discharged pus and dead bone ever since at intervals.

Admitted Oct. 22, 1900. At the upper end of right tibia marked swelling and tenderness. Scar of previous injury. Very painful. Joint motions normal.

Operation.—Oct. 24, 1900, an incision was made over crest of tibia, opening an abscess of considerable size in the soft parts. Bone was covered with thickened periosteum, 1/16 inch thick. Periosteum was retracted and tibia of nearly double normal size, very dense and hard, exposed. A trephine hole through a cortex of more than double normal thickness opened a pus cavity, containing about half an ounce of yellow pus. The marrow canal was practically occluded above and

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below this cavity by dense endosteal bone. With chisel and gouge the cavity was enlarged upward and downward until vascular marrow was reached. The cavity was cleaned out with 95 per cent. carbolic acid, followed by alcohol. All of the abscess wall also was curetted and carefully removed. The cavity was filled with blood clot according to Schede's method. The clot broke down and disintegrated and left the cavity lined with pale, unhealthy granulations.

Nov. 28, 1900, an attempt was made to utilize the regenerating power of the periosteum to obliterate the bony defect. An incision six inches long was made along the crest of the tibia, including the sinus. The periosteum was reflected and the dense tibia removed for a length of about four inches, except for a thin layer of cortical bone, attached to the periosteum, at the back of the tibia, as in Case 9. The tibia was practically all ivory bone and no definite marrow canal was seen, but the cavity was enlarged in both directions until the dense bone became more vascular. The periosteum then was approximated and sutured, although a triangular dead space had to be left at the junction with each portion of the shaft. The skin also was sutured and pressed firmly on the bone. A large plaster bandage was applied.

Results.—There was some sloughing of the edges of the wound at the middle of the incision, but upper and lower portions healed by first intention. Bony thickening was evident at the end of forty days, although a small sinus persisted. The patient was discharged wearing a plaster three months after the operation with a rather soft tibia of about one-half normal size, and a small sinus, in which dead bone could not be felt. The patient walked on the leg four and one-half months after the operation, and has done so ever since.

Examination April 2, 1903. Patient walks without limp. Leg is considerably smaller than normal leg. There is a marked concavity of the leg, beginning just above the tibial tubercle and extending down to the middle. The tibia is firm, not tender, a little wider than the normal tibia, but of about one-third less diameter. There is a slight vertical trough in the front surface of the bone, in the middle of the incision. It has not been possible to get the patient to come for an *x*-ray picture.

The case is not a complete success. The regeneration of the tibia has been sufficient to give a satisfactory functional result, but the persistence of the sinus is disappointing. I suspect that the cause is the cortical strip that was not removed.

The cases above presented are not selected cases, except Cases 1, 2, 5 and 6. Those cases were operated on by

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other surgeons, and by their permission have been presented here because they illustrated some special feature of the process of bone regeneration. The cases do include all of my own cases of disease of the large bones operated on by the method previously recommended, in which sufficient time has elapsed to determine the result of operation, except one case of resection of the inner half of the clavicle for tubercular disease. In that case there was complete regeneration of the removed portion of the clavicle, with a satisfactory sternoclavicular articulation. I have also in a few cases operated on small bones, e. g., phalanges, by this method, and succeeded in obtaining complete healing and regeneration. There has been a considerable number of cases operated on by this method by other surgeons at the Boston City Hospital, with exceedingly satisfactory results.

CONCLUSIONS.

A careful study of the cases here reported will show that the following statements in regard to the treatment of osteomyelitis are justified:

1. In the acute stage of osteomyelitis, drainage of abscess in the soft parts alone is not sufficient. The bone marrow is infected, and must be drained. Removal of a sufficient amount of cortical bone alone is all that is required to give perfect drainage to the bone marrow. Curettage and disturbance of the marrow causes extensive destruction of the endosteum, which, if left alone, has in a limited number of cases operated on early, sufficient power of regeneration to repair the bony defect without the formation of a sequestrum. Under those circumstances a very early operation on the cases is necessary.

2. In the subacute stage it is desirable to remove the necrotic shaft, completely or partially, at an early stage in order to take advantage of the power of regeneration of the periosteum. The periosteum either before or after the beginning of periosteal ossification has the power of regenerating a completely or partially removed shaft of bone.

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3. For mechanical reasons the manipulation of the periosteum is easier after ossification of the periosteum has begun, but while the membrane still is plastic. Moreover, the rapidity and surety of perfect regeneration seem greater at that time.

4. The operation consists of an incision through skin and ossified periosteum down to necrotic shaft, reflection of the periosteum, removal of the shaft, either entire or partial, folding of the plastic periosteum in such a way as to approximate the internal layers, suture of the edges by absorbable sutures, suture of the soft tissues, with, in both cases, provision for moderate drainage and complete immobilization.

5. The success of the operation is naturally greater when asepsis is provided for by careful drainage preceding the operation and by careful removal of all infected material and tissues at the time of operation.

6. After removal of the necrotic shaft well-marked ossification of the new periosteal shaft appears between the twentieth and fortieth days, and the shaft is solid enough for use in locomotion in from four to eight months. If the epiphyseal line is extensively destroyed, considerable shortening of the limb may result.

7. The regenerating bone at first becomes much larger than the original shaft was and is entirely composed of solid periosteal bone, with no marrow canal. This enlargement probably is due to the fact that the bone is less completely calcified than it is later. In time the size of the bone decreases almost or quite to that of the original shaft, and, finally, judging from *x*-ray photographs, a marrow canal is formed. This fact suggests that the size of bones may be due to two factors, heredity and environment, and that the ultimate size of the bone, therefore, is due to the function required of it.

8. The chief difficulty in completing the restoration of the shaft is to obtain complete union of the regenerated shaft to the epiphyseal line or to the portion of the normal shaft that remains. Slight necrosis and sup-

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puration may persist at this point after the repair otherwise is complete, and may demand minor operations to remove small fragments of necrotic bone. Union at these points may be delayed, but ultimately always has taken place.

9. The best time for the operation ordinarily is about two months after complete drainage of the acute infection.

10. This operation is the operation of preference, and is especially applicable when an accessory bone which can act as a splint is present.

11. The anatomic, functional and cosmetic results obtained by this operation are much superior to those obtained in any other way in cases of large bony defects due to acute infection of bone.

12. Where no accessory splint bone is present it may be impossible, in special cases, to maintain the contour of the affected bone by the above-mentioned method. In such cases advantage can be taken of the power of central growth possessed by the shell of periosteal bone in its *early* stages. This means that the necrotic bone must be removed just as soon as the periosteal shell is sufficiently advanced and solid to maintain contour and bear the weight of the limb. Roughly, this stage is reached when the thickness of the periosteal shell is equal to one-quarter of the diameter of the original shaft.

13. The time when this condition exists can be determined by *x*-ray examination and by palpation.

14. If the necrotic shaft is removed at this time it leaves a solid cylinder of periosteal bone, very vascular, but partly calcified, analogous to the bone seen in an early external callus, and this shell has sufficient power of central growth to fill up large cavities. The rate of central growth seems to be markedly slower than that of peripheral growth. Persistence of sinuses is longer than in the preceding method, partly from a delay of closure of the cavity, and possibly from a failure to remove small fragments of necrotic bone at the time of operation.

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15. This method of operating leaves at first bone very much larger than the original bone, but, as in the preceding case, ultimately the bone diminishes in size and slowly approximates that of the original bone.

16. In the chronic cases more or less sequestrum surrounded by an enormously thick shell of dense cortical, more or less ivory-like bone, exists.

17. The power of repair of dense cortical bone is very slight or practically wanting. Removal of sequestra leaves a more or less extensive cavity in bone, surrounded by a wall of dense bone, lined with unhealthy granulations, which has no tendency to close.

18. The most satisfactory methods ordinarily recommended for the closure of such defects are the aseptic blood clot, or obliteration of the cavity and approximation of skin flaps. The aseptic blood clot aims to fill the defect with dense scar tissue, but does not lead to regeneration of bone, and requires for its success greater asepsis than ordinarily can be obtained in extensive osteomyelitis. The skin flap method may close the cavity, but does so at the expense of great bony destruction.

19. From one semi-successful case, from a consideration of the general process of regeneration of bone by the periosteum, and the successful results obtained in the subacute cases, it seems likely that better results can be obtained by removal of both sequestrum and involucrum and the use of the regenerative power of the periosteum.

20. In removing a portion of a shaft under such circumstances, the excision should be carried sufficiently far into the normal shaft to get above a medullary canal, occluded by dense, ivory bone, and reach vascular marrow.

21. Finally, the most satisfactory results in treatment of acute osteomyelitis can be obtained by complete drainage of soft tissues and marrow in the acute stage, with the removal of extensive necroses, if they occur, at a secondary operation undertaken about two months later, and by adaptation of the regenerative power of the periosteum for the formation of a new shaft.

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DISCUSSION

ON THE PAPERS OF DRS. BOTTOMLEY AND NICHOLS.

DR. DE FOREST WILLARD, Philadelphia—It is not only the ordinary practitioner who is dilatory in diagnosis, but there are many surgeons who are slow in making up their minds and the golden opportunity is lost. Every case of osteomyelitis is infective, and we know that it needs as prompt attention as does a case of acute appendicitis. It should be recognized in the first forty-eight hours; it should be operated on in the first forty-eight hours. It should be operated on as soon as the diagnosis is made, whether it be of a streptococcus infection or a staphylococcus infection, and therein I would differ with Dr. Bottomley. In regard to the infection: I believe that the streptococcus infection is particularly serious, but in either case cutting inside the medullary cavity of the bone, freeing it from pressure and from infective elements is the only method which promises relief from total, or large destruction of tissue. The ordinary practitioner, and still less the surgeon, ought not to allow these cases to go on to destruction, suppuration and death. These cases are practically dying from sepsis when they come into our hands, and they have been treated for what? For that bane of progressive medicine, "rheumatism." If we could strike the term rheumatism out of the surgical world, it would be a blessing. One of the most potent destroyers of men, women and children is that cloak of ignorance, inattention and neglect, "rheumatism." How many cases we see dying day by day with an abscess containing ounces of pus, and the physician still treating it for rheumatism, or for typhoid fever. This is not an uncommon thing—every surgeon sees it over and over again. What is most needed is early, correct diagnosis. The treatment is plainly indicated. Where we have the evidences of rapid infection, with increasing pain, and deep-seated tenderness, there is only one rational treatment, that is to operate at once, relieve pressure and establish thorough drainage from the medullary cavity of the bone. The opening can not be made too quickly or too freely.

DR. J. CLARK STEWART, Minneapolis—I think it is most opportune that these papers should have been read to-day, because we have been hearing so much of the various forms of abdominal surgery, particularly that of ulcer of the stomach, gall-bladder disease and appendicitis, while it is rare to hear papers on osteomyelitis. I overheard a remark while in my seat, which I hope the gentleman who made it will pardon my repeating. When Dr. Nichols took the stage he said, "What, another paper on osteomyelitis; they must have a great deal of osteomyelitis in Boston," which reminded me of Dr. Oschner's story in regard to gall-bladder disease in Rochester, and I think that Dr. Nichols might answer very much in the same way that Dr. Mayo did: "We diagnose our cases of osteomye-

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litis in Boston." I think, without doubt, that osteomyelitis occurs in the practice of every man here, and possibly oftener than he recognizes, and there is no question that a very large percentage of the cases are primarily diagnosed erroneously. The diagnosis of these cases as rheumatism, which Dr. Willard mentioned, is probably the commonest error made, this being especially true of the subacute and chronic cases. Among the acute cases the diagnosis of typhoid is often made, and this error is a very serious one in causing delayed treatment. It has been my lot to see several cases treated in a general hospital as typhoid until the abscess presented at some external point, and this, of course, has not the excuse of the same diagnostic error earlier in the history of the case when severe sepsis may so mask the local symptoms as to make the resemblance to typhoid quite striking. The leucocytic count ought to clear up all these obscure cases, as there is regularly a decided leucocytosis in all acute cases of osteomyelitis. The early diagnosis of osteomyelitis is unquestionably the important point, and with the facilities at our command ought to be made in most cases without great difficulty. In the subacute and chronic cases the difficulty of diagnosis is very much greater, and frequently there is no diagnosis made until a bone lesion is discovered at the bottom of the superficial abscess cavity. Fortunately, in these forms early operation is not of so great importance as in the acute cases. In regard to Dr. Nichols' paper there were two or three points in which I was particularly interested. One was the instruction that in early operations you should cut in the medullary cavity and drain the bone without interfering with the marrow. This seems to me dangerous as a general rule, for while I have no doubt that in many cases operated on early, one is able to say whether or not marrow is infected, still judging from my own experience there are cases with multiple foci scattered through the marrow where it would be extremely difficult without removal of the marrow itself to determine the limit of the infection. In regard to Cushing's operation for the removal of the whole bone, it seems to me that this is unnecessarily severe and liable to misuse, for there are a great many cases of partial osteomyelitis in which a much less extensive operation will secure perfectly satisfactory results. In many cases you can remove the sequestrum, clean out the cavity and get primary union by organization of a blood clot, and in other cases by the slower method of packing, the final results are very satisfactory. Personally, I have had very little experience with the Cushing operation, and the results which he reports in cases of total necrosis are certainly very brilliant, but I doubt whether it should displace the other methods which have stood the trial of time.

Dr. Richard H. Gibbons, Scranton, Pa.—Those of us who

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have been taught by William T. Detmold, James R. Wood, Thomas M. Marco of New York, and D. Hayes Agnew, the Grosses and our distinguished ex-chairman and teacher, Dr. Willard, need not fail to make a diagnosis of osteomyelitis nowadays, or in much earlier times. When I first began practicing medicine, thirty years ago, Detmold taught that pain of a dull character in bone was due to one of two causes, either syphilis, or inflammation that would result in abscess. If syphilis, one will get pitting on pressure over the tibia, whether there is inflammation or not, or how extensive it may be, whereas you will get but slight pitting if due to non-syphilitic inflammation of bone. Long since, I have been applying to suspected bone the test which the dentist applies to the questionable tooth. As Dr. Murphy has said, you will not get pain by pressure, unless it is long-continued, but you will get pain by percussive pressure. However slight it may be, you will get painful response by this method, even in the first hour of the attack. The thing to do before opening up or trephining inflamed bone is to locate the seat of the infection, by gently tapping over its supposed site. I have had considerable experience in this kind of work in the anthracite coal regions of Pennsylvania, where many of the boys engaged in and about the mines become infected, and I have chiseled out bone throughout its length, and I have never had a bad effect, although I chiseled the bone all the way from the head of the tibia to the ankle joint. In one case I trephined and then guttered the entire bone, down into the malleolus. This was in an old man, and he recovered. These cases ought to all get well by operation, promptly performed, unless there is a tubercular infection in connection with the trouble.

Dr. J. B. Murphy, Chicago—I wish to congratulate the gentlemen on the practical points in the papers, and I wish to speak particularly on the second paper; I desire to still more forcibly emphasize the point of early diagnosis in acute infective osteomyelitis. What do we mean by early diagnosis in acute infective osteomyelitis? In what way is the physician of importance to his patients in a case of acute osteomyelitis? He is of importance to his patient in only one way, and that is when he makes a diagnosis inside of the first forty-eight hours. He is only of value to the patient when the case is diagnosed and operated on inside of the first forty-eight hours. Can it be done? Yes. The history of a case of osteomyelitis is so classic, so typical and so uniform that one can make the diagnosis ten hours after infection has occurred, or ten years, by interrogating an individual who was present at the time of the infection. What is the order of symptoms? The acute pain is usually preceded by a chill, followed by high temperature. The pain occurs usually in the extremities of the long bones, and in the majority of cases in children is not associated during

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the first forty-eight hours with effusion into the joint close to the focus of the disease, differing in this particular from rheumatism, which it is so uniformly erroneously diagnosed. The pain and sepsis increase hourly, but there is no local sensitiveness. Now then, what takes place in the third twenty-four hours after the infection? It is purely a symptomatic expression of pathology. During this period there occurs septic intoxication, acute absorption, high temperature, delirium, and all that goes with it. And with the advance of pathologic changes, with the increase of infectious products, with increasing pressure within the medulla of the bone from the bacterial invasion, we have destruction of the bone tissue, both by the toxic and biotic action of the infective flora, acting under great pressure. Rapid absorption continues until there is destruction of a vessel in one of the Haversian canals and the escape of the pus into the subperiosteal space. In the early stages of a case of acute osteomyelitis, there are no signs of inflammation on superficial pressure over the bone. I mean, during the first forty-eight hours, while the infective material is confined and restricted by the bony wall. In the third day of the infection, we usually have an escape of the pus from the center to the subperiosteal space, and sensitiveness to superficial pressure. But there is a sign that is an important one from a practical standpoint in the early stages; deep and continued pressure elicits pain and frequently indicates the position of the infection, even while the infection is still entirely within the bony wall. This will aid in making the diagnosis of the location of the focus of the infection. When the pus elevates the peritoneum, there is rapid necrosis as the circulation is cut off from without and within. In forty-eight hours one may have complete destruction of the entire shaft of the bone. Therefore, if we are to be of service and beneficial to the patient, we must relieve that infection focus from the condition which is so dangerous in any tissue of the body, namely, infection under pressure, by making an incision down into the bone and allow the infective material to escape and thus avoid necrosis. We have just as perfect a guide to the source of infection as we find in many other cases of infection. One should drill a hole through the bone into the seat of the infection and allow the pus to escape from the bone, and thus relieve the intoxication and avoid necrosis.

If the general surgeon will get that window in the bone inside of the first forty-eight hours, he will save the patient from destruction of the bone, from the possibility of involvement of the joint, from the danger of fatal sepsis, and put him in condition for the line of demarcation to form, so that he will have but one small sequestrum. Then the case goes on and gets well, and the dead bone is easily removed through this window, after the separation of the sequestrum, usually in six

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weeks. Chills, high temperature, local aching and no sensitiveness in the first forty-eight hours, except on deep and continued pressure for one or two minutes, when the pain becomes excruciating, are very strongly in favor of acute osteomyelitis and demands as prompt surgical intervention as acute infectious peritonitis.

Dr. Edward H. Nichols, Boston—One or two points brought out in the discussion deserve some mention.

As regards the question of diagnosis: during the past five years I have had an opportunity to see many of these cases during the acute stage, at the Boston City Hospital, both on my own service and on that of the other surgeons, who have kindly allowed me to see their cases, and I quite agree with all that Dr. Murphy says in regard to the desirability of early diagnosis, if we are to expect the best results. I do not agree, however, that the early diagnosis always is easily made. In some of the cases the typhoid symptoms come on so early that the patient is too stupid to notice the pain, and the cases may be treated as typhoid fever by excellent diagnosticians. In other cases the joint pain and swelling may be so extreme as to entirely obscure the bone affection, although monarticular pain, especially in children, always should arouse at least a suspicion of osteomyelitis.

In regard to the reparative power of the marrow: the integrity of the cortical bone is dependent on the integrity, both of the periosteum and of the endosteum. Extensive stripping of the periosteum usually produces considerable necrosis of the cortex; if the endosteum also is destroyed marked necrosis of the cortex is certain. Thence if one trephines into infected marrow and curettes out the remnant of undestroyed endosteum he destroys the membrane which, in some cases at least, might regenerate the infected marrow, and maintain the integrity of the inner layer of the cortex. No one would, of course, remove the periosteum because he found an abscess between it and the shaft, and the same thing applies to the removal of the endosteum.

In regard to the removal of the necrotic shaft. It is not always necessary to remove the entire diaphysis. It may be sufficient to remove one half, or whatever portion of the diaphysis is necrotic. The removal of the entire diameter of the necrotic shaft is, however, much preferable to removing merely a shell of apparently necrotic cortex. When a mere shell of cortex only is removed it will be found, if the cases are followed for a number of years, that recurrences take place in a large majority of cases, and permanent cures are not common. The cases where removal of a superficial shell gives a permanent cure are usually cases of periostitis with little involvement of the marrow.

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THE SURGICAL TREATMENT OF UNDESCENDED TESTICLE.

A FURTHER CONTRIBUTION.

ARTHUR DEAN BEVAN, M.D.
Professor of Surgery, Rush Medical College, University of Chicago, and Surgeon of the Presbyterian Hospital.
CHICAGO.

At the Columbus meeting of the American Medical Association I read, before the Section on Surgery and Anatomy, a paper entitled "Operation for Undescended Testicle and Congenital Inguinal Hernia," published in THE JOURNAL of the A. M. A., Sept. 23, 1899. Since that time I have had the opportunity of operating on a further series of cases, representing practically all the varieties of this malformation and have made some improvements, made necessary by difficulties occasionally met, which make operative reduction of the misplaced testicle possible in almost all cases; and places, I believe, the operation in a position where it should be accepted as a standard surgical procedure.

A further reason for again presenting this subject is the fact that a number of my colleagues have informed me that they have had difficulty in understanding and in carrying out the operation which I recommended, and I have felt that a series of plates illustrating the various steps of the procedure might make the matter clearer. The plates which I submit are sketches from life of the various steps of the operation.

I am inclined to believe that where an operator fails to succeed it will be due to the lack of that anatomic

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knowledge which he must possess to enable him to unravel the shortened structures, and at a stroke of the knife and in half an hour imitate the normal descent of the testicle. I regard the operation as one of the most interesting examples of applied anatomy.

It will not be necessary here to review the normal de-

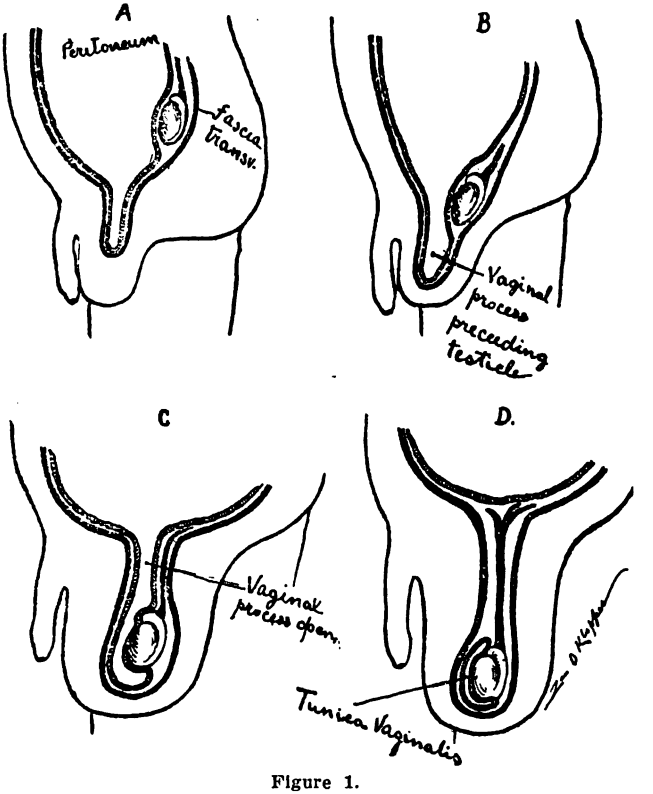

Figure 1.

scent of the testicle. Figure 1 shows graphically this descent: A. The first position of the testicle below the kidney and behind the peritoneum. B. Passing through the canal. C. In the scrotum, with open vaginal process, so that the general peritoneal cavity and the future tunica vaginalis are still continuous. D. The vaginal

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process obliterated, the general peritoneal cavity shut off from the tunica vaginalis. There is one fact in connection with the descent of the testicle which is of importance in the operative reduction and which is generally not known or misunderstood, and that is that long before the testicle descends through the canal the vaginal process of peritoneum has preceded it, lying in front of the gubernaculum testis and reaching into the scrotum.

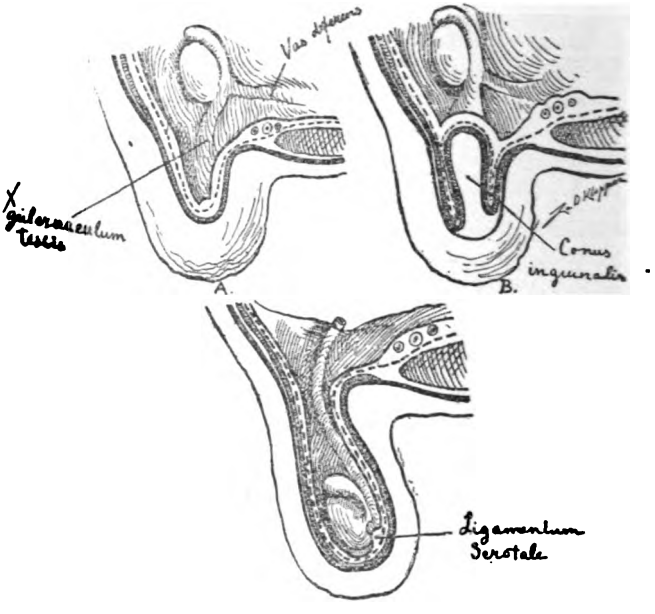

Figure 2.

The idea so prevalent among medical men that the testicle drags down a process of peritoneum in its descent is an error. I have found in all my cases, even where the testicle is well within the abdomen, a large sac of peritoneum, passing through the canal, occupying the space in front of the external ring and passing down toward or into the scrotum.

Figure 2 shows graphically the descent of the testicle in three stages, and shows the process of peritoneum and

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the gubernaculum testis preceding the testicle in the scrotum.

For clinical purposes, we may divide the malformations in connection with the descent of the testicle into:

1. Simple failure of the vaginal process to close, giving us the picture of congenital inguinal hernia, or at least a potential hernia.

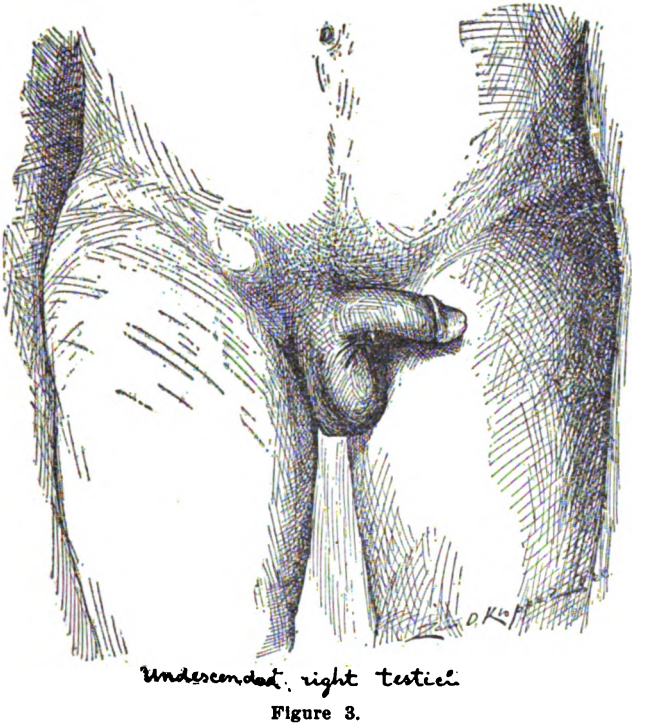

Figure 3.

2. Incomplete closure with such conditions as hydrocele of the cord.

3. Undescended testis which presents four types: (a) in the abdomen, in about its original position; (b) at the internal ring; (c) in the canal; (d) external to the external ring.

4. Misplaced testicle. (a) in the perineum; (b) on the thigh below Poupart's ligament.

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Undescended testicle occurs in at least 1 in 500, as shown by the statistics of the Austrian army, obtained from an examination of recruits. The malformation is a serious one, as it brings with it both mental and physical distress and it deserves more consideration from the medical profession than has been given to it. Even to-day almost no mention of the condition is made in our standard text-books on surgery, and the idea is generally

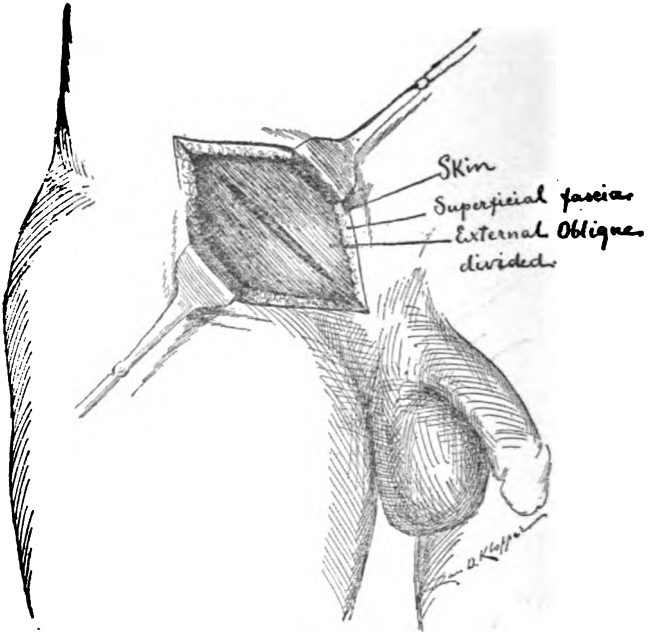

Figure 4.

prevalent among medical men that nothing can be done for the cure of the conditions, except removal of the testicle, if it causes trouble.

To-day, I believe the rule should be to operate and transplant to its normal position in the scrotum every undescended testicle which can be palpated. Those which can not be palpated should be operated on if they give rise to symptoms, or are complicated with hernia.

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Those which can not be palpated and do not give rise to physical distress, should be operated on and placed in the scrotum, if the malformation is the cause of mental distress to the patient. There are but few cases of undescended testicle where an operation is not indicated.

The dangers and discomforts of the condition of undescended testicle are much greater than those of the ordinary inguinal hernia and call more urgently for

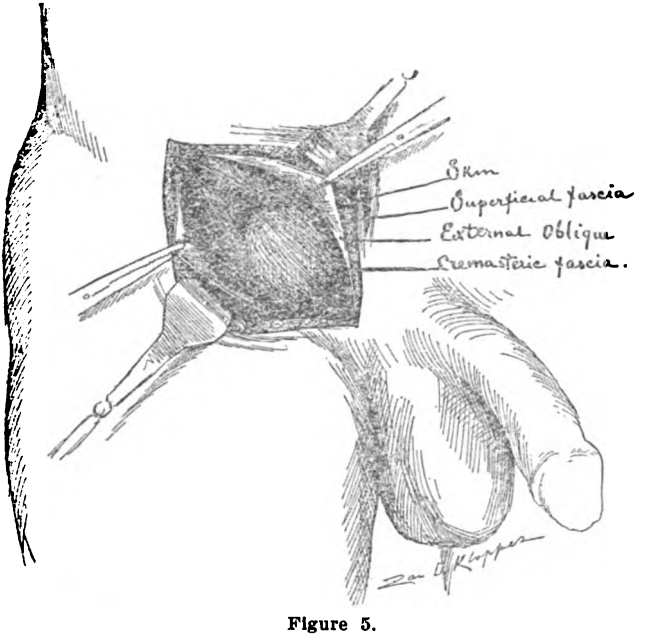

Figure 5.

operative relief. These dangers are, briefly, (1) the actual or potential hernia which is always present; (2) greater liability to, and greater danger from, inflammation of the testicle in its abnormal position; (3) injury to the organ from its exposed position, both external injury and injury from muscular contraction, such as coughing, lifting, etc.; (4) the greater danger of malignant degeneration (there can be little doubt that these

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undescended testicles are more often the seat of malignant disease than are normal testicles); (5) mental distress, due to the existence of the condition. This is an important factor in many cases. We do not hesitate to give our patients, suffering from hernia, the benefits of an operation for radical cure, and we should not refuse the cryptorchid the benefits of a surgical procedure, which, if properly performed, is as safe and as sure as

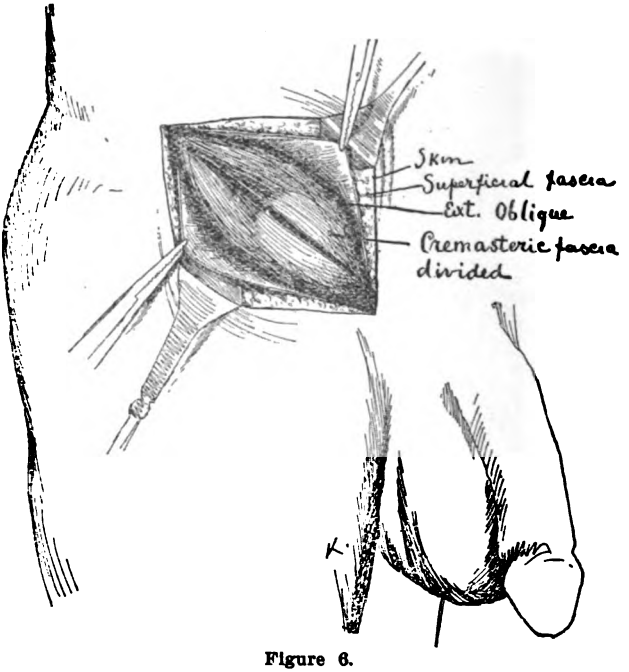

Figure 6.

a Bassini hernia operation and more urgently called for.

The first work of value in this line was done in 1881 by Max Schüller, and reported in this country in the *Annals of Anatomy and Surgery*. Schüller recognized the vaginal process of peritoneum as the chief factor which prevented the drawing of the testicle down into the scrotum and the factor which drew the testicle back into its old position, after operation. He advocated divi-

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sion of this vaginal process and stitching the testicle into the scrotum.

Schüller's work was a distinct step in advance, but his operation did not go far enough and has but a limited field. The operation which I have developed meets, I think, the indications better and has a much wider field of usefulness. I have developed the operation so that testicles well within the abdomen, which have never

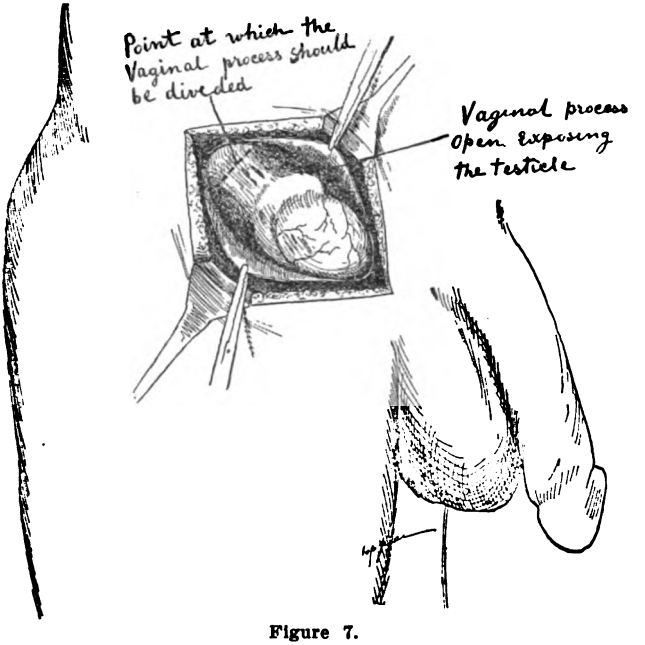

Figure 7.

been palpable, can be brought down and retained in the scrotum. Before describing the technic, which is the special purpose of this paper, I desire to say a word in regard to the age of selection. At what period of life, if we can choose, should these patients be operated on?

In my first paper, I advocated waiting until after puberty, on the ground that some of these testicles descended during puberty and the malformation was cured sometimes even without an accompanying hernia. I

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have changed my opinion decidedly on this point, because I believe that this descent at puberty is a rare occurrence, at least, that it happens in but a small per cent. of the cases, and again, I believe that it would be far better to have the testicle in the scrotum when the changes incident to puberty take place. I now, therefore, advocate the performance of the operation before puberty, when possible, I think best, between 6 and 12 years of age.

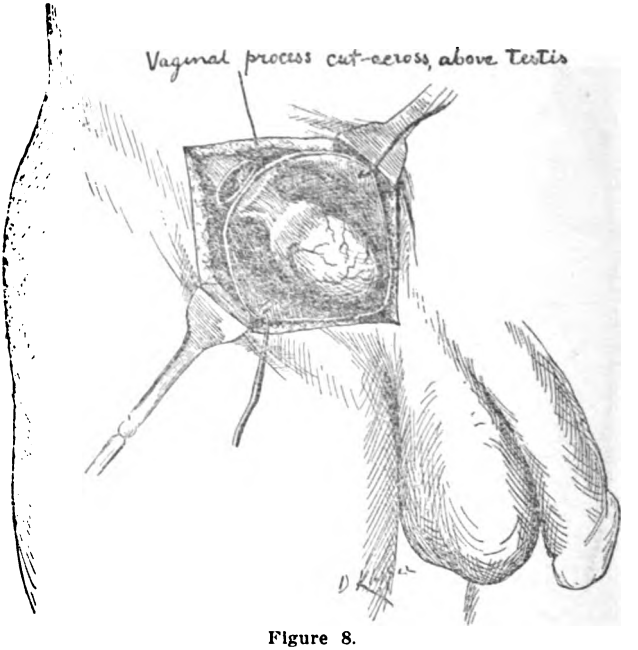

Figure 8.

DESCRIPTION OF THE OPERATION.

In operating on undescended testicle, when the organ is palpable, as in Figure 3, that is, in the canal or external to the external ring, the following technic should be pursued:

Make an incision three inches long over the canal. This should never involve the scrotum, or extend farther inward or downward than the external ring. This in-

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cision should divide skin and superficial fascia and the external oblique over the inguinal canal (Fig. 4).

The divided aponeurosis of the external oblique is drawn to each side and the cremasteric fascia is exposed (Fig. 5).

The cremasteric fascia and the thin underlying transversalis fascia is freely divided parallel with the canal (Fig. 6).

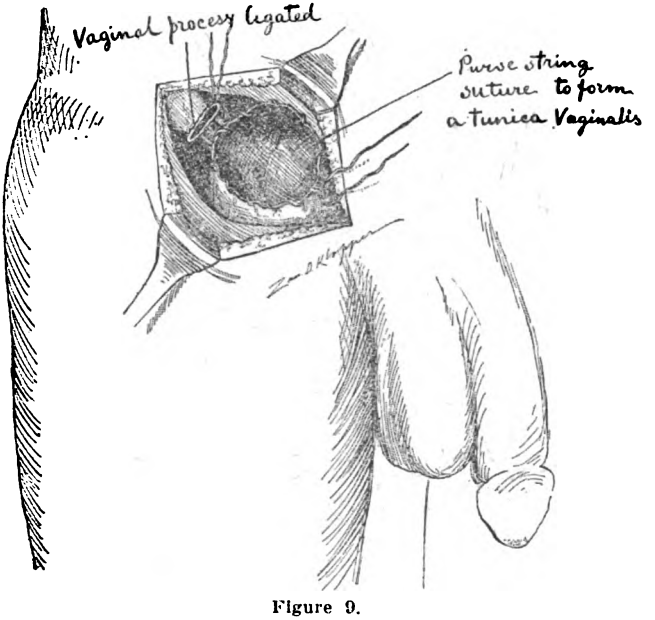

Figure 9.

This exposes the large peritoneal sac containing the testicle and continuous with the general peritoneal cavity. This sac is opened and the testicle exposed to view (Fig. 7). Frequently a projection of the omentum is found in the sac.

It is not necessary to make as large an opening into the sac as is shown in Figure 7. The peritoneum is then cut across at the point shown in Figure 7, and is carefully separated from the cord which lies beneath.

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Figure 8 shows the vaginal process of peritoneum, cut across above the testicle. The vaginal process is then ligated, as in the neck of the hernia sac in a hernia operation, care being taken to ligate well up at the internal ring. That portion of the peritoneal sac in contact with the testicle is closed with a purse-string suture,

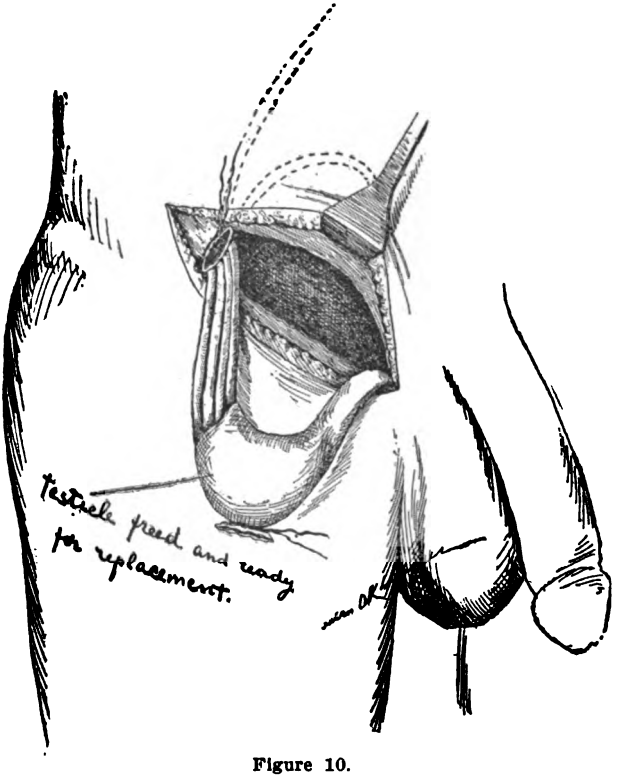

Figure 10.

and thus forms a tunica vaginalis for the testicle (Fig. 9). The testicle is now lifted out of its bed, and the cord is gently pulled on, so as to lengthen it as much as possible. In doing this, shortened bands of connective tissue will be seen as tense bands in the cord, and these should be torn across with tissue forceps. The cord should thus be stripped of all the surrounding fascia,

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leaving nothing but the vessels and the vas deferens. When this has been accomplished the spermatic vessels and the vas, which lies behind the posterior layer of peritoneum of the abdominal cavity, should be separated from the peritoneum by careful blunt dissection, with the finger introduced into the abdominal cavity. The

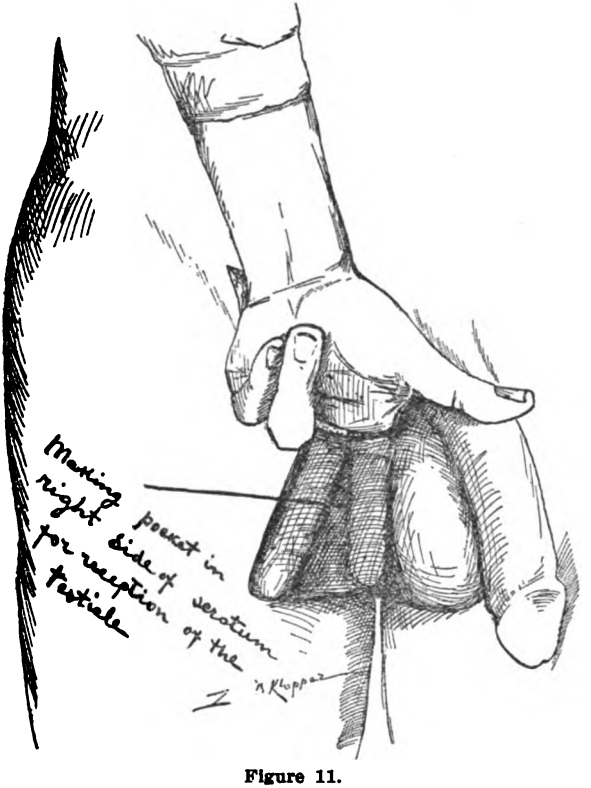

Figure 11.

spermatic vessels will be found passing upward and inward, and the vas downward and inward from the internal ring, and this divergence can be plainly seen. The cord should be so lengthened by these maneuvers that the testicle can be layed on the thigh three or four inches below Poupart's ligament (Fig. 10).

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With blunt dissection with the fingers, a large pocket should be made in the scrotum for the reception of the testicle (Fig. 11), and the testicle dropped into it, where it should remain without tension on the cord. A purse-string suture should now be placed at the neck of the scrotum to retain the testicle in position. This suture should pass through the superficial fascia and the ex-

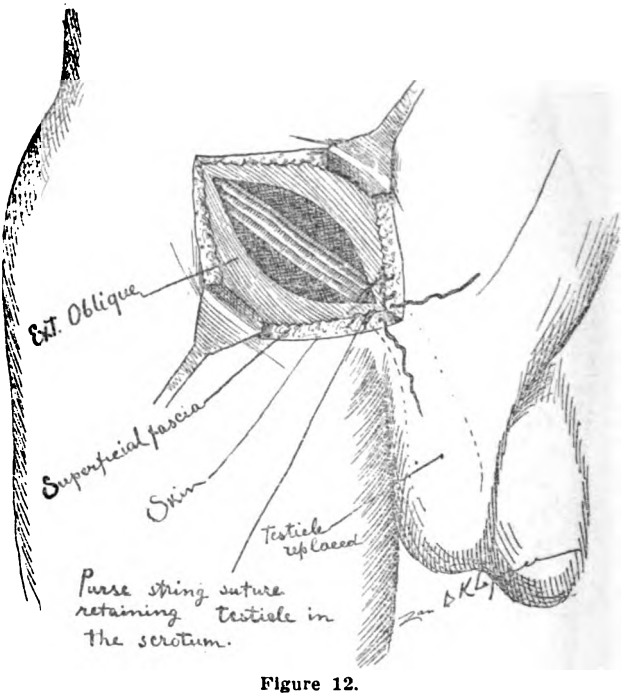

Figure 12.

ternal oblique on both sides of the incision; that is, both the internal and external pillars of the external ring, and above the cord. When this suture is tied, the testicle is securely retained in its scrotal pocket (Fig. 12). The incision is then closed, as in a Bassini operation, except that we do not transplant the cord; that is, we bring the conjoined tendon and Poupart's together above the cord (Fig. 13). We then suture the incision in the

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external oblique with continuous suture (Fig. 14), and, lastly, close the external wound. I have employed formalin catgut for the buried sutures and horsehair for the skin sutures. A fairly firm, not uncomfortable, compress over the canal, retained with spica bandage, completes the operation. The horsehair sutures are removed on the tenth day, the patient allowed on his feet on the fourteenth day.

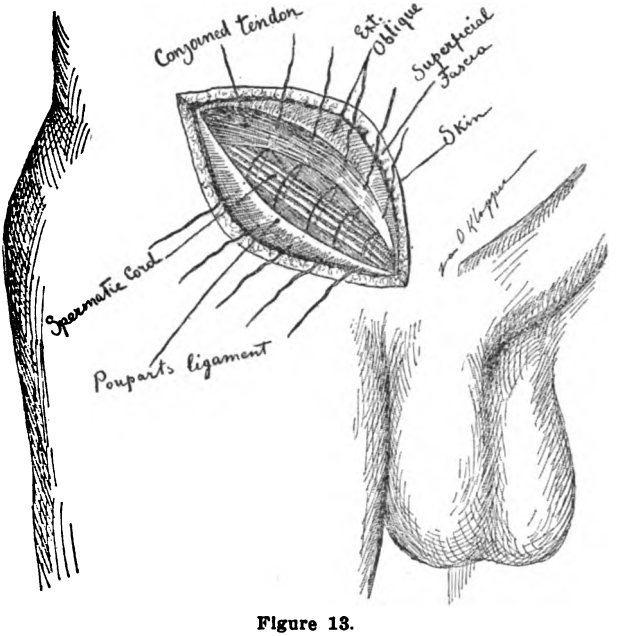

Figure 13.

The technic I have described will answer in a large majority of cases, but I have found by experience that in operating on cases in which the testicles are not palpable, and are well within the abdomen, and in some few cases when the testicles are palpable, that I could not, by the method described above, free the testicle sufficiently to bring it into the scrotal pocket, without tension. In analyzing the facts in these cases, I found that the tense structure which prevented reduction were the

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spermatic vessels, and not the vas. The spermatic vessels run in almost a straight line from the internal ring to the abdominal aorta and the ascending vena cava and renal vein. The vas, on the other hand, makes a long sweeping curve in its course from the internal ring to the base of the bladder. The artery of the vas accompanies it and follows this same curve. The vas is the essential organ in the spermatic cord.

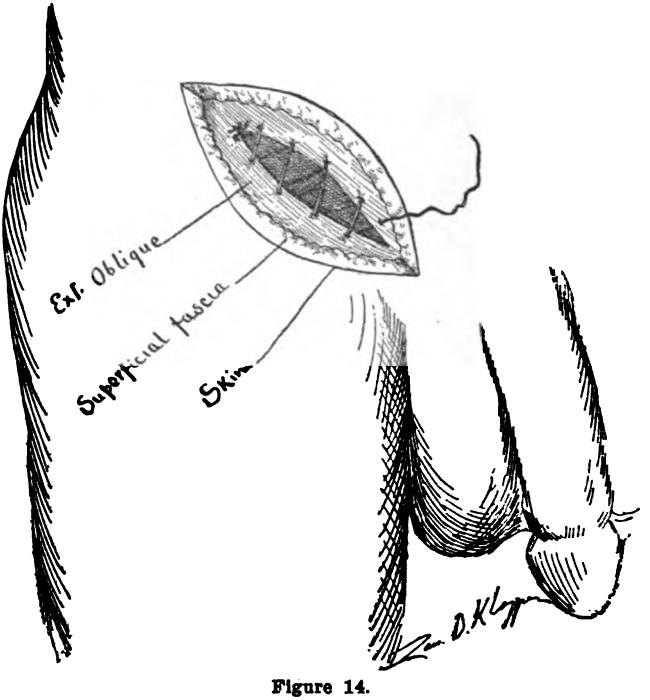

Figure 14.

The question which confronted me in some of my difficult cases was whether the spermatic vessels were structures essential to the integrity of the testicle, or whether they could be safely sacrificed, in those cases in which the testicle could not be sufficiently freed without dividing them.

Reasoning from a clinical experience of more than a-

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hundred varicocele operations in which I had removed all of the structures of the cord, with the exception of the vas and its vessels, and had never seen gangrene of the testicle, or any apparent interference with its nutrition, I concluded that the spermatic vessels could be safely sacrificed in those cases where it is necessary to divide them in order to bring the testicle well down in the scrotum. I have, therefore, in a number of cases

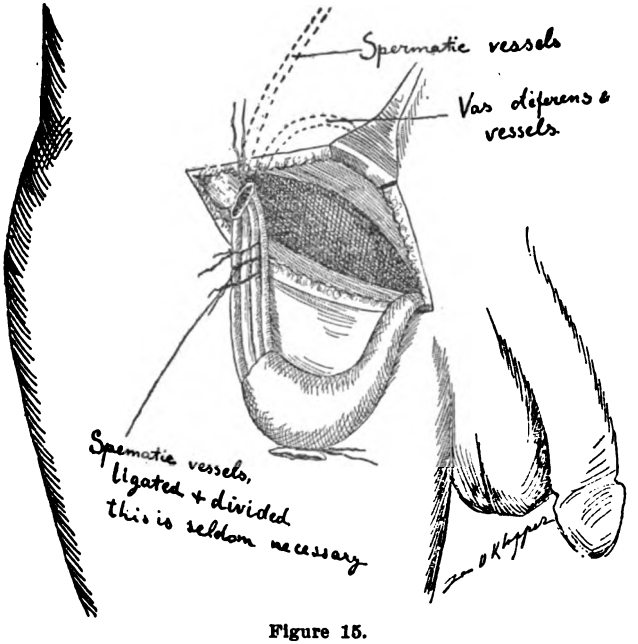

Figure 15.

ligated the spermatic vessels at two points and divided between, as shown in Figure 15, and have had no evidence of interference with nutrition; in fact, these have been among my most successful cases, from the standpoint of clean and rapid recovery.

After my first operation of this kind I found that J. Griffith,[1] writing on the effects on the testes of ligature

1. Journal of Anatomy and Physiology, vol. xxx, p. 81, 1895.

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of the spermatic artery and spermatic veins, and of both artery and veins, had demonstrated that these vessels could be sacrificed without any permanent interference with the function of the organ.

The explanation is this: The testicle is supplied by two arteries, the spermatic from the aorta, and the artery of the vas from the inferior or middle vesical. These anastomose freely; neither are terminal arteries, and either can be sacrificed without endangering the vitality of the testicle.

Since adopting this seemingly radical, and yet perfectly safe, sacrifice of the spermatic vessels, I have had no difficulty in bringing the testicle down into the scrotum, even in cases where it was well within the abdominal cavity, and where it had to be hooked out of the abdominal cavity and held with some tension to keep it out beyond the internal ring, until the shortened structures were divided.

I desire to urge the general adoption of operative treatment for undescended testicle. By the operation the testicle can be placed in its normal position in the scrotum, where it certainly has a better chance of developing into a normal organ than it has if it is allowed to remain in its abnormal position. At the same time, the patient is cured of the actual or potential hernia, which is always present, and is freed from the dangers and discomforts which result from the malformation, and this can be accomplished by an operation which is as safe and as sure as the operations for radical cure of hernia, and, to my mind, is much more urgently called for.

The operation requires of the operator a very clear conception of the normal anatomy of the region and the abnormal anatomy of the malformation, but otherwise presents no greater difficulty than does a Bassini hernia operation.

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DISCUSSION.

DR. W. T. ECKLEY, Chicago—I shall speak on four points: (1) The diaphragmatic ligament of the primitive kidney; (2) the gubernaculum; (3) the inguinal ligament of the primitive kidney; (4) the probable factors concerned in cryptorchism. At an early period the mesonephros and indifferent sexual gland are in a retroperitoneal bed of mesodermic tissue. That portion of the mesodermic tissue cephalad of the sexual gland is called the diaphragmatic ligament of the primitive kidney; the portion caudad of the gland is the inguinal ligament; while the part corresponding to the gland becomes the mesorchium or mesovarium, according to sex. With the disappearance of the primitive kidney, the diaphragmatic ligament atrophies. The inguinal ligament develops the gubernaculum. The gubernaculum is attached, cephalad, to the sexual gland, and its inverting peritoneum, caudad, to the inguinal region and bottom of the scrotum. By traction it produces a test-tube-like processus vaginalis—a preformed structure for the reception of the testicle. The emphasis placed on the occurrence, together with cases reported by the essayist of congenital hernia and cryptorchism in the same individual, seem to clear up a hitherto controverted anatomic question, viz., whether the testicle and processus vaginalis descend at the same time. In one case at least I can corroborate Dr. Bevan's opinion that the processus vaginalis is preformed for the reception of the testicle. By a strange hypervivacity the gubernaculum may reduce to processes of peritoneum, one of which favors the occurrence of infantile hernia.

Two factors figure conspicuously in the causation of cryptorchism: (1) the spermatic vessels; (2) an unobliterated diaphragmatic ligament of the primitive kidney.

DR. CARL WAGNER, Chicago—It is not only from a psychologic standpoint of view that these cases of undescended testicle appeal for relief, but also from the anatomic and pathologic points of view, for there may be serious dangers which may be obviated through such surgical devices as Dr. Bevan's. In this connection I wish to report a case of undescended testicle, in which this condition is responsible for the loss of one testicle. It took place in a young boy, who fell about fifteen feet. He complained of severe pain in the left inguinal region. I saw the boy the second day after the accident and found a swelling the size of a small walnut in a region corresponding to the seat of the internal ring. Further examination disclosed the fact that there were no testicles contained in the scrotum. Thus I concluded that the swelling contained the undescended testicle which through the force of the fall had been thrown into the inguinal canal. On opening up, I found the testicle tightly encircled by the pillars of the internal ring, around its

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middle, and gangrenous. It became necessary to incise the internal ring upward in order to free and ligate the testicle off, which could not be moved downward the least bit.

I feel very much encouraged by this paper to operate on undescended testicles, and thus prevent dangers of similar character.

Dr. Willard Bartlett, St. Louis—There is a certain pathologic condition which must guide us as to the time at which this operation should be performed. What Dr. Bevan has said about doing the operation early is undoubtedly true. The undescended testicle is of value to us only to facilitate the development of the child. It is known that the boy who possesses two undescended testicles develops into the manly type, whereas the infant that is robbed of two normal testicles develops into an effeminate type. Knowing as we do, then, that the undescended testicles are of value only to further the development of the child, and knowing as we do that the infant develops into the girl type if the testicles are removed, it would seem that they should not be removed in the early years. On the other hand, the danger of malignant disease from undescended testicles after they are reduced is just the same as though they had been left in the abdomen. Consequently the logical conclusion must be drawn that such a testicle must be removed entirely, if you do anything to it after about the age of 18 or 20 years, whereas, as Dr. Bevan has said, the psychologic considerations would demand that they be brought down in the scrotum, if anything be done with them early.

Dr. A. J. Ochsner, Chicago—This paper is of very great importance, because up to the time at which Dr. Bevan first wrote on this subject the general tendency was to substitute the removal of the organ for its replacement. In the former paper Dr. Bevan emphasized the fact that the reason why the former attempts at replacement of the testicle had been unsuccessful was because the organ had not been loosened. He showed how the organ was held by a curled-up condition of the tissues of the cord, and that by unfolding these tissues it was possible to place it in the scrotum. Since hearing this paper read at the Cincinnati session of this Association, I have many times performed this operation and, except in the first case, in every instance with perfect satisfaction. In the first case one point made by Dr. Bevan in his original paper had escaped my attention, which I learned later in looking up the paper, namely, that the organ may be almost perfectly loose and still be held by the peritoneum. The tissues of the cord may be relatively loose and yet there may still be a certain degree of tension. Realizing this degree of tension which has been described, I have always performed the Ferguson operation in preference to the Bassini, making use of the

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principles brought out by Dr. Bevan and, with the exception of the first case, with perfect satisfaction.

DR. WILLIAM L. RODMAN, Philadelphia—It has been my lot to see a great number of cases of this condition, and I feel it is better to incorporate the testicle in the scrotum than it is either to excise it or to leave it in the abdominal cavity, for three reasons: The first is that the patient would, of course, very much rather have the testicle in its normal place, and the moral effect is very much better. Second, the place for the testicle is where it is least likely to undergo any form of malignant disease, and certain it is that all such organs are much more likely to undergo malignant change if left in the abdominal cavity than if they are placed in their normal position. I know some one has denied this, but I think the evidence is absolute that the undescended testicle is prone to undergo degenerative change. The third reason is that the testicle in the inguinal canal can expand and grow and develop in a way that it could not if it remained in the abdomen, and that is the chief reason why these organs are practically without function, and why a person with two undescended testicles is practically impotent. Naturally, there will be a much better chance for the development of the testes if the operation is done early, as Dr. Bevan says, and not after puberty. I think undoubtedly he was correct in changing his position and saying that these operations should be done before puberty. The last case that I operated on was a child about 8 or 10 years old. He was the son of a physician living in New Jersey. He had become very much concerned about the future of the child, and rightly, I think, insisted on the operation being done early. In one case which occurred in a young man I was able to bring both testes down and anchor them in the scrotum in the way indicated by Dr. Bevan. I am glad to say that the results have been very good, although I believe the testicle, even if brought down into the inguinal canal, will never become functionally active.

DR. ARTHUR DEAN BEVAN, Chicago—In regard to the question raised by the last speaker, I think that we must always be guided by the conditions which are present. The operation is performed, of course, with the idea of giving relief to the individuals who have undescended testicles. Of course, these cases are almost always complicated by hernia, and the point I wanted especially to make is that by this method we have only to bring the testicle down and do not have to apply any tension. My experience has been rather limited in this work, about twenty cases, but I have not seen more than one where we could not bring the testicle down without any tension.

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OPERATIVE TREATMENT OF BILATERAL CICATRICIAL ANKYLOSIS OF THE JAWS.

A CONTRIBUTION BASED ON A REPORT OF A CASE OF TWENTY YEARS' DURATION, RELIEVED BY A SERIES OF PLASTIC AND OSTEOPLASTIC OPERATIONS.

RUDOLPH MATAS, M.D.
NEW ORLEANS.

The occurrence of permanent trismus or "locked jaws" ("ankylosis," "occlusion," "constriction" of the jaws) may result from a variety of well-known causes which, according to the permanent or temporary nature of the cause, or the parts involved in the pathologic process, vary in their prognosis and in their amenability to treatment. It is not my purpose to discuss this subject systematically, but to limit my remarks to the consideration of that most frequent, distressing and intractable variety of trismus in which the jaws are permanently locked and immobilized by the formation of rigid cicatricial bands and masses which hold the maxillæ in an unyielding clasp, reduce the capacity of the buccal space and thus more or less completely interfere with the movements of mastication. (Ankylosis spuria mandibulæ of the older writers.)

While the movements of the lower jaw may be restricted by the formation of cicatrices in the soft parts outside of the mouth in consequence of destructive lesions, accidental injuries, pathologic processes and surgical operations which cause great destruction and scarring about the face, the peribuccal and perimaxillary tissues, as is often seen as a sequel of burns, gunshot wounds, car-

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buncles and malignant ulcerations, etc., these are not, as a rule, so serious from the functional or surgical point of view as the class of cases in which the immobility of the jaws is caused by a destruction of the lining mucosa of the mouth. In these cases the mucous membrane is usually destroyed by progressive ulceration or gangrenous inflammations which, spreading on the inner surface of the cheek, give rise to either unilateral or bilateral ulcerations, which in healing leave large areas of dense, retractile, cicatricial tissue. Many of the most destructive, gangrenous and ulcerative infections of the mouth which are responsible for the loss of the oral mucosa occur in early life (noma, cancrum oris, scarlatina, diphtheria, mercurial stomatitis, syphilis, tuberculosis), and, as a result of the tender age of the patients, lead, when neglected, to a series of secondary changes, which influence most injuriously the entire development of the face, thus adding great disfigurement to a distressing interference with a most important function.

When cicatricial trismus occurs in early childhood the development of the lower jaw is greatly interfered with, and it remains rudimentary and infantile in size and shape. The chin is dwarfed, small and retracted, giving to the face an asymmetrical and ungraceful appearance (micrognathism), which is most striking when viewed in profile (the so-called "bird face"). The eruption of the permanent teeth is likewise interfered with; the molars make their appearance in vicious attitudes; more often they are deviated from a vertical to an oblique or horizontal axis and the grinding surfaces face the tongue instead of the teeth of the upper jaw. The front teeth of the upper jaw project beyond the lower set; the lower teeth are imperfectly developed, unhealthy and covered with thick, offensive salivary incrustations and food accumulations. The secretions of the mouth are usually malodorous from stagnation, and there is a perceptible dribbling of saliva when the angles of the mouth are involved in the contraction. In spite of the rigidity of

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the jaws, the reduced buccal space, and the inability to separate the teeth, and of their extremely defective mode of feeding, it is remarkable how well these patients adapt themselves to these conditions and succeed in keeping up a fair state of general nutrition. More often, however, these persons succeed in nourishing themselves because of the absence of teeth or irregularities in their development, which allow the food to be forced between the missing teeth or interdental spaces. The entire muscular apparatus of mastication undergoes atrophic changes from arrested development and disuse; in fact, the entire innervation and vascular supply of the inframaxillary portion of the face suffers from the same cause and retains an infantile form, markedly contrasting with the upper jaw and face, which continue to develop and grow in normal proportion until adult life.

To add to the complexity of these cases, we find that the cicatricial masses in the rear mouth undergo, in some instances, a process of osseous infiltration, which transforms the scar tissue into a solid piece of bone, of the consistence of old callus, which permanently unites the upper and lower maxillæ into a single immovable bone.[1] This is particularly true of those fortunately rare cases in which the original causal infection has spread from the mucosa to the periosteum, exciting this to the formation of hyperostoses by the proliferation of osteoblasts in the budding granulation tissue.

When these ossified bands exist, they are usually found in the posterior part of the mouth, in the vestibular space, extending from the upper gingival border to the inner surface of the body of the lower jaw, as far forward as the bicuspids or even the commissure of the mouth. In dealing with cicatricial occlusion within

1. Numerous cases of ossification of intrabuccal bands will be found reported in the literature; the cases reported by C. Esterle, B. Holt, Marchiafava, Sebastian, Walter, Sarrazin, Heath and others, are fully referred to in the index catalogue of the Surgeon-General's library, vol. vii.

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the mouth, the resistance, thickness and density of the scar bands must be considered. Not only is the cartilaginous and osseous transformation of these bands a matter of importance, but their situation and limitations are of still greater importance in determining the prognosis and the mode of procedure.

As shown by Verneuil, who so ably studied this form of maxillary ankylosis 40 years ago, we should try to distinguish, for practical purposes, the cases in which the cicatrices occupy the anterior from those which contract the posterior regions of the oral cavity. When the scar bands are limited to the anterior (facial) part of the vestibule and lips, the prospect of operative relief is excellent and the prognosis very favorable; but when the scar masses are formed on a level with the last molar or in the pterygoid region along the angle, body, and ramus, the possibility of restoring the mobility of the lower jaw without resorting to some form of intrabuccal plasty, combined with osteotomy and pseudarthrosis, is reduced to a minimum. Even a comparatively superficial destruction of the mucous membrane in the retrovestibular space and along the inner surface of the ramus is sufficient to cause permanent contraction and immobility of the jaw, because in the normal state the mucous membrane is tightly stretched over and adherent to the periosteum and peribuccal tissues. Inflammatory and ulcerative processes starting in the mucous membrane at this level, therefore, are easily propagated to the periosteum and bone, forming dense, fused, unyielding masses, which do not permit of anatomic differentiation into their component elements.

It is evident from what has been stated that the problem which confronts the surgeon who would attempt to give relief in such cases by mobilizing and liberating the lower jaw is far more complex than a superficial glance at the subject would imply. In fact, the division or excision of the constricting cicatricial bands is only

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one of its phases, and other factors in the problem must be considered before anything like a functional restitution of the lower jaw can be obtained. In view of the arrested development of the jaw, of the atrophied and shortened muscles and ligaments which are concerned in the control of the inferior maxilla, and the vicious attitude of the teeth, it is evident that neither a functional, cosmetic or anatomic restitution, in a complete sense, can be expected by any mode of treatment. Nevertheless, even in such extreme cases, fortunately very rare at the present time (when the opportunities for surgical relief are given to all in almost every community), the surgeon may still hope to restore the mobility of the lower jaw sufficiently to permit of easy feeding and mastication, and thus greatly relieve the condition of these unfortunate sufferers.

In the treatment of the rare and grave type of cases which we have in view, no single method of treatment will suffice, and it is only by judiciously combining a variety of procedures that we may hope to release the jaw and obtain a certain degree of mobility which will permit the patient to open his mouth and to masticate solid food.

In unilateral cases, and especially where the scar tissue only involves the angle of the mouth and lateral aspect of the cheek, the problem is solved with comparative ease, and a simple plastic operation will generally suffice. In the symmetrical or bilateral cases involving the deeper recesses of the oral cavity, osseous sections must be added to dermal transplantations to obtain the desired result. None of the ordinary methods by which the jaw can be forcibly separated by mechanical dilators, wedges, conical screws or mouth gags, can be expected to give even temporary relief; to have attempted any procedure of this sort on the patient whose history has furnished the text for this paper, would have resulted simply in breaking the teeth or

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fracturing the jaws. The simple division of the ossified cicatricial masses with knife and chisel would have been dangerous on account of the great depth of the scars, and could not be considered.

Mears' method of dividing the scar tissue after creating a mucous lined tunnel under it with a seton-like ligature, valuable as it is and worthy of trial in simpler cases, was evidently impossible here.[2]

The various procedures which have been recommended for the permanent relief of cicatricial occlusion of the jaws, exclusive of the simple palliative and mechanical methods previously referred to, may be grouped under the following heads:

1. Division and excision of the scar tissue with substitution of transplanted skin or of mucous flaps, for the lost mucosa.

2. Division and detachment of tendinous insertions and aponeurotic expansions of the muscles of mastication at their surface of attachment to the lower jaw (masseter, pterygoid, etc.), after division of the cicatricial bands in the mouth.

3. Creation of a new point or center of motion in

2. Dr. Mears' method is thus described by the author ("The Operative Treatment of Occlusion of the Jaws," by J. Ewing Mears, THE JOURNAL A. M. A., Sept. 18, 1897): "In performing this operation a long-handled, slightly curved needle threaded with a strong aseptic twisted-silk ligature of sufficient length, is introduced at the angle of the mouth on the inner surface and carried carefully into the space between the cicatricial mass and the buccinator muscle and the point made to emerge at the posterior border of the last molar tooth of the lower jaw—at which point the posterior border of the cicatricial tissue can usually be felt. The ligature is now seized with the toothed forceps, the needle withdrawn, the ends tied and the ligature left loosely in the channel thus formed. As the intention is not to divide the mass by the ligature, this is permitted to remain without traction, the formation of the canal lined by normal mucous membrane being facilitated by drawing the ligature backward and forward, and thus destroying any adhesions which may form. When a probe passes readily and smoothly and without provoking bleeding, it may be assumed that the canal is lined by normal mucous membrane. This is usually accomplished in three weeks, when the scar tissue is divided with a blunt-pointed bistoury introduced into the canal." A mouth gag is then introduced between the teeth, and the mouth forced open to the widest extent. This is repeated at intervals until the mouth is healed, etc. Dr. Mears' experience with this method appears to have demonstrated its permanent value.

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the body of the jaw (pseudarthrosis) by osteotomy in front of the resisting and unyielding scar masses when these exist in the postbuccal space.

4. Excision of the temporomaxillary joint, condyle or part of the lower jaw, with or without associate myoplasty.

EXCISION OF SCAR AND SUBSTITUTION OF HEALTHY SKIN.

The first group embraces the greatest number of suggestions, some of these very ingenious. We should note that in recent years and since the advent of a more aggressive and radical technic for the cure of malignant diseases, the indications for the extirpation of the mucous membrane of the mouth in dealing with growths of the face, and especially of the cheeks and lips, have increased. Surgeons have been compelled to tax their ingenuity considerably in the effort to prevent the contractions that necessarily follow an extensive extirpation of the mucosa.

In the endeavor to find a suitable material, free from the retractile tendency of scar tissue, a number of plastic operations have been devised (cheiloplasty and meloplasty), in which the transplantation of pediculated skin flaps have figured largely. Autoplastic skin flaps obtained from all parts of the face, neck and cheek and upper extremities have been utilized; mucous flaps from the mouth (palate and lips) have been tried less often; Thiersch grafts have been utilized freely as secondary aids to epidermization of raw surfaces; even heteroplastic flaps taken from the mucous lining of the dog's mouth have been transplanted from the living animal, but with very doubtful results.[3]

Among the more practicable and useful of the numerous plastic operations that have been suggested is the

3. See Halsted's case of cicatricial contraction of the jaws (unilateral), treated by transplantation of a mucous graft taken directly from a dog's mouth. Johns Hopkins Hospital Bulletin, December, 1890.

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meloplasty of Jäsche.[4] This operator, after splitting the cheek from the angle of the mouth to the masseter, including the cicatrized mucosa, sutured the skin of the cheek, on each side of the fissure, to the gums and mucosa of the vestibule inside of the mouth. After adhesion of the skin has taken place, two semilunar skin flaps of sufficient length are dissected out of the skin of the cheek and attached to the upper and lower lining of the artificial oral cleft, leaving the flaps attached to the gums, thus inverting the free skin edges into the mouth. After this the flaps are sutured in the mouth by their edges and the cheek is closed over the defect, restoring the mouth to its normal dimensions. Gussenbauer's[5] method is in some cases still more serviceable. This author, after splitting the cheek through and through, from mouth to masseter, and thus dividing all resisting scar tissue freely, cuts a trapezoidal flap out of the lateral aspect of the neck and folds it over the denuded masseter into the mouth where it is sutured to the mucosa. After adhesions have been contracted, the pedicle is cut off and the graft is turned into the mouth throughout its free extent, with its dermal surface facing the teeth. After suturing it in place to the edges of the cleft and angle of the mouth on the inner side, the cheek is closed. Jäsche's and Gussenbauer's operations are typical of the modern methods of autoplasty and differ from the earlier operations,[6] in which attempts at plastic repair were made by sliding flaps in which the dermal surface remained external and no allowance was made for secondary re-

4. Jäsche, G.: Ueber die operation der Mundklemme. Med. Zeitung, Russland, St. Petersburg, 1868, xv, 209. The same: Zur operationen Behandlung der narbigen Kiefferklemme. Arch. f. Klin. Chirurg., Berlin, 1868, ix, 226-229.

5. Gussenbauer, C.: Ueber ein neues Verfahren der Stomatoplastik zur Heilung der narbigen Kelfferklemme. Arch. f. Klin. Chir., Berlin, 1877, xx, 526-536, 1 pl.

6. See a noted case reported by Valentine Mott, "A Case of Rigidity of the Lower Jaw and Taliacotian Operation," Amer. Jour. Med. Sci., 1831-2, ix, 47-50, 1 pl.

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contraction of the flap surface on the inner or mucous side of the mouth.

Gersuny opens the mouth through an external incision made along the lower border of the jaw from the chin to the angle. A skin flap large enough to cover the defective area in the mouth is dissected from the submaxillary region and is completely mobilized, with the exception of a pedicle made of periosteum, cervical aponeurosis and other subcutaneous tissues. With this pedicle as a base of vascular supply, the flap is turned into the mouth with the skin surface facing the teeth and is attached to the free margins of the defect. The external incision is then closed. This method has been variously modified by v. Hacker, Eiselsberg, and Kraske. Its chief merit is that it diminishes the scarring in the face. On the other hand, Bardenheuer utilizes a pediculated flap borrowed from the hairless parts of the forehead with its pedicle attached to the lateral surface of the nose. This flap is turned into the mouth, where the skin is substituted for the defective mucosa. When the skin of the cheek has been destroyed with the mucous membrane, an additional pediculated flap is borrowed from the neck and made to cover the cheek in such a manner that the raw surfaces of both flaps are brought together; thus the forehead flap is made to serve as mucosa and the neck flap covers the defect in the cheek. This method has been adopted, with modifications, by Oberst, Rötter and others. In other cases, Bardenheuer filled the defects in the cheek with pediculated flaps borrowed from the arm.

Partsch of Breslau prepares his flap for transplantation before attempting to use it in the mouth by first dissecting and mobilizing it in the neck, after which its raw surface is covered with Thiersch grafts. In this manner the flap is covered with epidermis on both surfaces. When epidermization has been accomplished, the diseased area in the cheek is removed and the graft thus

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prepared is attached permanently *in situ*. In cases in which the gap to be covered in the mouth is very great, Hahn and Israel cut a very long pediculated flap from the neck and attach it to the mouth with the skin surface looking inward; after this has become adherent, the long pedicle is detached at its root and what remains of the flap is folded on itself so that the raw surfaces come together, leaving a thick double layer of skin at the seat of the defect. Hahn's flaps begin at the clavicle and end at the mamma. The flap is dissected upward toward its clavicular attachment and the mammary end is attached to the mouth; subsequently, when this has adhered, the clavicular pedicle is divided and the flap is folded on itself like a booklet, forming a double layer, as in the previous case. Following the same plan, Israel makes his flap extend from the angle of the jaw to the clavicle and utilizes them in the same way.

Czerny has applied similar methods by cutting out a long flap with its pedicle at the zygoma and its free extremity as low down as the middle of the sterno-mastoid; this flap is folded on itself and made to cover the defect in the cheek at the same sitting. In connection with these plastic transplantations of the skin into the mouth (meloplasty), it is well to remember with Lexar,[7] to whom I am indebted for a large number of the preceding references, that the hope once entertained that the skin when transplanted into the mouth would lose its cutaneous peculiarities and finally cease to grow hair, has never been realized, though it has been shown by Ritschl that the skin does undergo atrophic changes in the course of time. Tufts of hair will grow in the mouth years after the transplantation of the skin. Thiersch mentions a case in which hair formed in this way 21 years after the operation. Hence the importance of selecting skin from normally hairless

7. Handbuch der Praktischen Chirurg., Bergmann-Bruns-Mikulicz. Bd. 1.

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surfaces whenever possible. In operations on the cheek, the preservation of Stenson's duct and its replantation into the mouth is very important to prevent "weeping" scars.

In a few suitable cases the mucous membrane of the mouth in the vicinity of the excised areas may be utilized to cover the defect. We have already referred to Halsted's unique experience when he attempted to relieve cicatricial trismus by transplanting a fresh non-pediculated graft from the mouth of a dog to that of a boy suffering with this defect. I am not aware that the final outcome of this experiment has ever been published, but it is evidently an extremely uncertain method, which offers little prospects of practical results. In regard to the autogenic mucous grafts, Bayer has covered a defect in the cheeks by covering it with a mucous flap transplanted from the hard palate. In a case of carcinoma of the cheek, Oberst succeeded in overcoming the defect by cutting out two pediculated flaps from the inner (mucous) surface of the upper and lower lips respectively. He split the cheek to the masseter, extirpated the neoplasm and dissected the flaps from the upper and lower lips on their inner surfaces, sutured them together along their edges, leaving the raw surface outward, and the edges of the check-incision were closed over them. But these methods are of very limited application as compared with the cutaneous flaps, which are generally accessible and are far more manageable.

MYOTOMIES AND MYOPLASTIES.

In the second group of procedures that have been suggested and applied for the relief of cicatricial ankylosis, we should mention the division of the muscles of mastication or the detachment of their tendinous insertions with the object of creating more advantageous points of attachment and thus increasing the mobility of the lower jaw. It is doubtful that any permanent results can be obtained solely by myologic sec-

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tions or reimplantations, except in cases of purely myopathic occlusion of the jaws. Such cases are reported in the literature in which good effects have been claimed, but the operations were either too recent when reported to prove the permanent success of the method adopted, or the procedures have been applied to cases in which the cicatricial contractions involved only the anterior region of the mouth and cheeks. In other instances the myotomies have been assisted by making a section of the jaw and creating a false joint, which is the really effective agent.

Gurdon Buck (1840), J. Carnochan (1846), J. R. Wood of New York (1850), J. W. Schmidt of Boston (1854), Müller and Little of New York, were among the first surgeons to report cases of tenotomy and division of the masseter and temporal for the relief of cicatricial constriction of the jaws in this country. The surgeons of other countries have reported a number of observations. LeDentu, in a more recent period, obtained a satisfactory result in a case in which the rigidity of the jaws was apparently caused by permanent contraction of the masseter and internal pterygoid, by making an incision along the angle of the jaw, through which he detached the masseter from its lower insertion as high up as possible; the adhesions of the mucosa to the body and ramus were also detached, and the internal pterygoid was also mobilized with a periostome. After these parts had been freely mobilized, he was able to open the mouth with a gag and kept the jaws wide apart for several weeks until the muscles had become permanently inserted at a higher point of attachment.

More frequently, sections of the muscles (masseter, temporal) have been made with the view of interposing muscular and aponeurotic flaps between the sections of the lower jaw, which is divided at the angle or at the ramus with the view of creating a false joint. In order to prevent the subsequent union of the fragments, mus-

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cular flaps borrowed from the masseter and pterygoids are interposed and sutured between the edges of the divided bone to insure the permanency of the pseudarthrosis. Verneuil first suggested this modification of Esmarch's operation and Helferich has adopted the same idea, in cases of true ankylosis of the temporomaxillary joint, by turning down a flap of the temporal after excision of the condyle. Lenz, Mikulicz, Riegner, Henle and Rochet have reported good results from this combined myo-osteoplasty.

OSSEOUS SECTIONS AND OSTEOPLASTIC OPERATIONS.

Sections of the lower jaw have been made through the condyle, the coronoid process, ramus and the body of the jaw. More frequently the temporomaxillary articulation has been excised or a linear section of the body (Rizzoli) or a cuneiform excision of the body (Esmarch) on a level with the angle, and including the angle, are now made, with the view of creating a pseudarthrosis.

Rhea Barton of Philadelphia was the first to suggest osteotomy for the relief of ankylosis in orthopedic surgery. Berard first suggested osteotomy of the condyle in ankylosis of the jaw. Carnochan, Richet, Dieffenbach took up the same idea and favored it about 1846. W. Grube[8] is credited as the first, according to Mathé (quoted by F. Gunyon[9]), to perform an osteotomy of the ramus for ankylosis of the jaws by intrabuccal section, in 1863.

A. Cabot of Boston and Koenig have clearly defined the indications for temporomaxillary excision. Baumgartner, Küster, Kraske and Bergmann have contributed modifications in the operative technic, which are more or less advantageous. Excision of the temporomaxillary joint is now restricted to cases of true ankylosis of this joint, and the myoplasties which have been suggested by Verneuil and others previously

8. Arch. f. Klin. Chir., Berlin, 1863, iv, 165-182.
9. Dict. Encycloped. des Science. Méd. (Déchambre).

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referred to, simply aim at the prevention of recurrence of the ankylosis by the new formation of bone tissue between the excised fragments. The most decisive step in the operative treatment of cicatricial constriction was not made until Esmarch and Rizzoli almost simultaneously and independently of each other suggested and performed, in 1854 and 1857, the operations which bear their names. The object of both operators was to create a false joint in the body of the lower jaw in front of the unyielding cicatricial bands. Esmarch removed a section of bone and Rizzoli made a linear osteotomy. The two procedures have been variously modified, but Esmarch's operation is the one generally preferred, as it is the most certain to prevent a reunion of the bone fragments. The modification first suggested by Bruns, Bonnet, Wagner and Heath, by which a triangular piece of bone is removed from the body of the jaw, including the angle, is the one now preferred. The operation is best performed by external incision and without opening the mouth (Levrat). The Gigli saw is particularly well adapted for this purpose. The external incision will also permit the masseter and external pterygoid to be detached from their insertions as a preliminary to the excision of the angle.

The immediate results of this operation are strikingly satisfactory in mobilizing the jaw; but in order to obtain the best results in long-standing cases, as in the instance here reported, the cicatricial tissue in the mouth must be excised and a flap of skin, transplanted from the nearest hairless region into the mouth, must be substituted for the missing or contracted mucosa. In bilateral cicatricial cases involving the deeper regions of the oral cavity, a combination of methods is indicated.

The selection of the method in each case must be made judiciously, according to the special conditions existing in the case. It must be remembered, however, in making Esmarch's pseudarthrosis that a false joint

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should be made on one side only, and that nothing is gained by a bilateral section of the body of the jaw. This has been done by some surgeons, but it is evident that they have overlooked the fundamental fact that by the division of the jaw on both sides by osteotomy not only is the nutrition of the middle fragment greatly impaired, so that it becomes an easy prey to infection and necrotic changes, but that all control of the isolated middle piece and the capacity to chew food, and even to open the mouth and close it, voluntarily, is greatly impaired, because of the separation and isolation of the middle fragment from the muscles of mastication. It is, therefore, important, in all bilateral cases, to limit the formation of a false joint to one side only, so that the function of the masseter, pterygoid and temporal of the other side may be maintained. The removal of the anterior cicatricial bands and substitution of dermal flaps by autoplasty will usually suffice to give to the patient motion and control of the jaw. Should more motion be required, the excision of the condyle, part of the ramus of the jaw (without injuring the temporal and pterygoid) on the side opposite the pseudarthrosis, will give room for the play of the muscles of mastication by increasing the temporomaxillary space. This last expedient is, however, only justifiable in cicatricial ankylosis of the grave osteogenic type herein described.

GENERAL CONCLUSIONS.

In cicatricial constriction of the jaw, the operative treatment must be guided by a full knowledge of the seat of the constricting bands; their extent, their density and their association with secondary developmental defects or associate lesions in the osseous, articular and muscular apparatus of the lower jaw. The age of the patient, the cause of the lesion, duration of the trismic condition, the seat and extent of the cicatrices, whether extra- or intra-buccal, are the most important elements in determining the final results of the operative treatment.

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2. The most intractable and difficult cases are those in which the lesions are symmetric and bilateral, which begin in inflammatory and necrogenic processes in the mucous membrane of the retrovestibular and pterygoid regions of the mouth in early childhood, and are neglected until atrophic, degenerative and developmental changes in the maxilla and its condyle have taken place.

3. The best results are obtained by early and persistent treatment.

4. In the complex and neglected cases of the class referred to (intrabuccal), no single operative method is sufficient to obtain permanent relief. The cases involving the anterior portion of the mouth and cheek are the most favorable for treatment, and the simple method of division of the cicatrices suggested by Mears will probably suffice. In the deeper or retrobuccal cases, a combination of methods, including autoplastic skin transplantations, osseous sections, with the creation of an unilateral pseudarthrosis (Esmarch), with or without myoplasty, will be required to obtain a moderate, but advantageous, degree of motion of the lower jaw.

5. Simple plastic operations to replace the lost mucous membrane by transplanting skin are necessary, but not sufficient in the deeper posterior bilateral cicatricial contractions. They must be regarded solely as adjuncts to the formation of a pseudarthrosis.

6. In making a false joint by Esmarch's or Rizzoli's method, it is important that the procedure should be limited to one side only, because a bilateral pseudarthrosis will result simply in increasing the mobility of the intervening fragment, with loss of voluntary control. The best results are obtained by unilateral pseudarthrosis, combined with bilateral plastic dermal transplantations, to which may be added, in the gravest cases, excision of the maxillary condyle on the side opposite the pseudarthrosis, without damaging the temporal, pterygoid or masseteric attachments.

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7. By the combination of the methods above presented and a prolonged course of maxillary gymnastics following osteoplasty, functional results may be obtained, even in the most forbidding cases, without, however, the expectation of attaining the surgical ideal, either as to cosmetic or functional results.

CLINICAL OBSERVATION.

E. S., age 28, white, male, farmer, was admitted to the Charity Hospital Nov. 14, 1900. The patient is a native of Louisiana; single; of good habits and gives an excellent family history; father and mother both living and healthy; has four sisters and five brothers all living and well. Has never had gonorrhea or syphilis and has never been addicted to alcohol. When 7 years old he had a fever which was called "brain fever," and during the treatment was given calomel, which caused a violent stomatitis and salivation followed by deep ulceration on both sides of the mouth and especially the inner surfaces of both cheeks. It was two months before his mouth was well, and after healing he found that he was unable to open his jaws in consequence of the cicatricial contraction of the mucous membrane. When 17 years old he had malarial fever and he was treated with calomel with the result that he was again salivated, leaving ulcers in his mouth which healed in two weeks. After these had healed his mouth was more firmly closed than ever and he had great difficulty in feeding himself. When he was 25 years of age he was again sick with malarial fever, and was once more treated with calomel, which was followed by the usual salivation and an ulcerative stomatitis which lasted several days. Since that time the original contraction of the mouth which had completely immobilized his jaws had greatly altered his physiognomy and had compelled him to subsist purely on fluid and semifluid foods. In 1898 a physician made an incision over the left condyle of the lower jaw, probably with the intention of resecting the condyle, but there is no evidence to show that this was accomplished. Several efforts were made at various times to force his mouth open by mechanical means, but nothing was obtained by these efforts except to cause him to lose several of his teeth.

Jan. 15, 1901, he was again admitted to the Charity Hospital and examined for the first time by the writer. The general examination showed a healthy man, apparently fairly well nourished, about 5 feet 5 inches in height and weighing about 125 pounds. The face at once attracted attention by the small and undeveloped appearance of the chin and by the immobility of the lower jaw, which gave a fixed, rigid and set expression to the face. The angles of the mouth were

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drawn down and were adherent, especially on the left side, to the lower jaw by a distinct synechial band. The front teeth (incisors and canines) were irregular, notched, carious and incrusted with tartar. They projected for a considerable distance in a forward and oblique direction over those of the lower set, which were even more irregular, carious and stained by calcareous deposits and tobacco juice. The gums were ulcerated and retracted from the teeth. A tendency to salivary dribbling was noticeable at the angles of the mouth. The chin receded and was small, contrasting with the upper half of the face, which was well developed; the hair of the beard, of a light sandy color, was scant and there was scarcely any growth of hair on the chin or lips. The cheeks were rounded and fully developed, contrasting in this way with the smallness and infantile appearance of the chin and lower jaw. The patient spoke without moving the jaws, and this gave his speech a peculiar and indistinct enunciation. The jaws were so firmly set that the point of a pocket penknife could scarcely be inserted flatwise between the front teeth. On attempting to explore the mouth with the fingers it was found that the entrance to the vestibule was blocked, on a level with the canines, by the existence of extensive cicatricial bands, which, beginning at the angles of the mouth, prevented further access to the space between the cheek and teeth on both sides. The back teeth and molars appeared to be in absolute contact. A probe could not be passed between the rows of the back teeth and only penetrated to the end of the vestibule by keeping it in close contact with the bicuspids and molars. Not the least impression could be made on the lower jaw by any manipulation. Evidently the inner surface of both cheeks was lined by a cicatricial mass, which had entirely replaced the normal mucosa. It was remarkable in this case, as in other reported instances, that the general nutrition had been maintained throughout the long period of twenty years that this condition had lasted, and that the patient had not suffered a great loss of body weight in spite of the notable interference with alimentation. This was partly accounted for by the fact that the patient had lost several of his teeth and had succeeded in feeding himself with milk, eggs, cereals, soups and other soft foods, such as chopped meats, which he crowded into his mouth with the help of his fingers.

In view of the extremely aggravated condition thus presented to us, the existence of a bilateral and extensive symmetrical constriction produced by cicatricial bands which had entirely replaced the mucosa of the vestibule and of the cheeks, and also of the atrophied, rudimentary and undeveloped state of the lower jaw and of the entire masticatory apparatus—we were undecided for a while as to the best course to pursue. It was plain that nothing could be accomplished by the

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usual mechanical methods of separating the jaws or of dividing the cicatrices by the simple intrabuccal methods recommended by some writers, more especially by Mears, as there was absolutely no room for any intra-oral manipulations. Nevertheless, after further deliberation I decided to divide the cicatricial masses on both sides by the procedure originally suggested by G. Jäsche, who described it nearly a half century ago, and which permits not only of a free visual exploration of the mouth, but also favors a substitution of the flexible skin of the cheek for the rigid and unyielding scar tissue after this has been divided and excised. This procedure appeared to be particularly applicable in his case, as the redundancy of the cheeks afforded an abundance of material for plastic work.

First Operation.—Feb. 1, 1901, the first stage of Jäsche's operation was undertaken. After a preliminary administration of one-quarter grain of morphin hypodermically, the cheeks were infiltrated along the line of the proposed incision from the angle of the mouth to the masseter, a little below the middle line of the cheek. The cutaneous incision was mapped out with an intradermal injection of one-fifth of 1 per cent. Schleich solution, and the subcutaneous tissue was made tense by massive infiltration of a 0.2 per cent. eucain B. isotonic saline solution injected with the author's infiltration apparatus. The dense tissues lying between the mucosa of the mouth, the ascending ramus of the jaw and the masseter were also infiltrated with the help of a long needle attached to the apparatus. An incision was then made which completely divided the cheek and opened the buccal cavity from the mouth to the anterior border of the ascending ramus of the lower jaw (Fig. 1). In doing this it was found that the mucous lining of the cheek had been completely replaced by a dense, thick scar tissue, which became harder as the ascending ramus of the jaw was approached. It was very difficult to divide this dense fibrous tissue with a knife, and as the end of the vestibular space was reached it was found necessary to resort to the sharp edge of a McEwen chisel to divide the scar tissue, which on the level with the last molars was found ossified and forming a bony bridge which clamped the two jaws and held them together as a single piece from one alveolar process to the other. By using the chisel freely the ossified tissue was divided and a considerable part of it was excised and removed. The cheek of the right side was anesthetized and treated in the same manner, the osseous bridge and scar tissue existing to the same extent as on the opposite side. After this had been done it was found the narrow space between the cheek and teeth was filled with a soft calculous mass formed by a mixture of tartar, stagnant food and precipitated tobacco juice, all of which had accumulated

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and formed a thick magma in this inaccessible space. After removing this stagnant mass on both sides we were able to explore the mouth and investigate the condition and relations of the teeth more satisfactorily. By insinuating the edge of the chisel behind the molars we divided all constricting bands and ossified masses to the ramus of the jaw, and by using the chisel as a lever we were soon able to pry open the jaw sufficiently to explore the interior of the mouth and determine the full extent of the constricting lesion. By further use of a conical dilator and by forcible manipulation with the hands we succeeded in separating the jaws 2½ inches apart, but we desisted from further efforts at this point for fear of breaking the delicate and undeveloped lower jaw.

After opening the mouth freely in this way we were at once struck by the vicious attitude of the permanent molars and

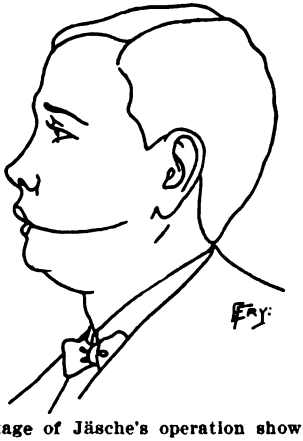

Fig. 1.—First stage of Jäsche's operation shown in profile. Incision from angle of mouth to anterior border of masseter.

bicuspids. In the twenty years that the constriction had existed the eruption of the permanent teeth had evidently been interfered with, and they had grown upward in an oblique direction, finally assuming a horizontal position so that the normal axis of each tooth was set at right angles to the alveolar margin; thus the grinding surfaces of the teeth were all turned toward the interior of the mouth. This abnormal attitude was much more marked in the lower than in the upper teeth. Having now obtained as much separation as was practically necessary for alimentation, we completed the first step of Jäsche's operation by suturing the cutaneous edges of the divided cheek flaps with the relics of mucosa and dense tissue which covered the upper and lower alveolar processes at the gingivobuccal junction. This was done with some diffi-

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culty, as the sutures would cut through the scar tissue whenever they were tied with even moderate tension. We therefore found it necessary to support the tissues by packing the large buccal clefts that we had created on each side of the mouth with strips of iodoform gauze and holding these in place with adhesive straps. Fortunately, on account of the abundance of skin covering the cheeks, there was no tension, we had little difficulty in maintaining the flaps inverted into the mouth until healing had taken place.

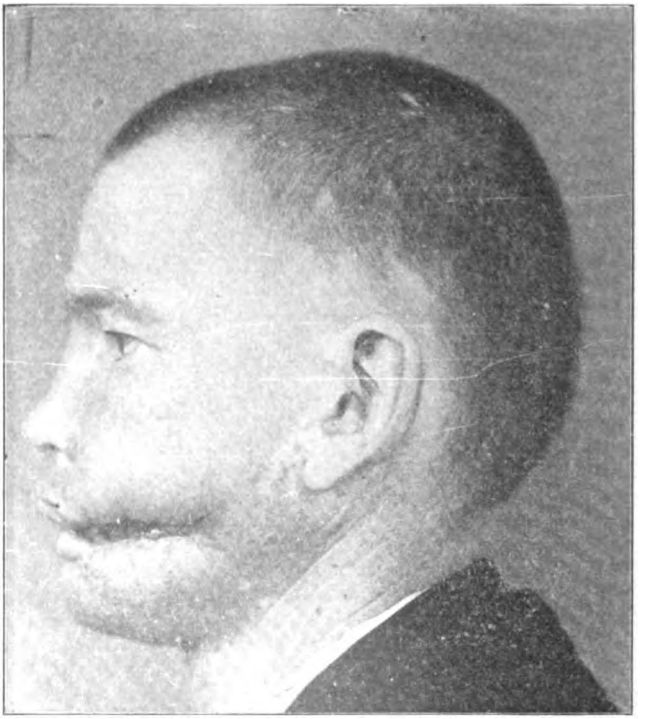

Fig. 2.—Profile, showing result after first stage of Jüsche's operation; a macrostoma or oral cleft remains as an extension of the mouth on both sides, to the masseter; the skin edges of the cleft are attached to the gums and vestibule of the mouth.

In the course of a few weeks the skin of the cheeks had united with the gums throughout the whole line of incision, and the appearance of the patient was that of a man with a huge oral cleft or macrostoma which extended from one masseter to the other (Fig. 2). After healing had taken place

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systematic efforts were made to widen the interspace between the jaws with the view of stretching the contracted and shortened muscles of mastication and of increasing as much as possible the impaired mobility of the lower maxillary. For this purpose several contrivances were used. In addition to the usual mouth gags (conical and Goodwillie's) a special contrivance by which elastic traction could be made on the lower jaw with rubber tubing was found particularly beneficial. This most effective appliance was used as follows: A heavy piece of rubber tubing 3½ feet long by ½ inch in diameter was stretched over the mouth in the cleft as far back as possible, behind the last molar so as to fit like a bit in a horse's mouth; the free ends of the tube were then crossed as a figure of 8 back

Fig. 3.—Separation of the jaws after division of the cheeks and scar tissue on both sides; first stage of Jäsche's operation (from a photograph).

of the neck and each end again carried down in front of the chest on each side, below each axilla, and tied over the back of the chest while the rubber was stretched (Fig. 3). The immediate effect of this was to cause a flexure of the head on the neck and chest, but by forcibly extending the head backward while the patient was in a horizontal position the elastic tension made on the lower jaw caused the mouth to open to the widest possible extent compatible with the resistance of the muscles of mastication. By persisting in the fullest extended attitude of the head all muscular resistance was gradually overcome and even ligamentous tissues yielded and the maximum amount of separation of the jaws was obtained with the

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least amount of traumatism or suffering to the patient. Whenever the patient would tire of the extension he would simply flex the head and the elastic tension would at once diminish sufficiently to give relief. In this way elastic extension could be kept up intermittently for periods of half an hour or more at a time, thus securing the benefits of prolonged treatment, which he learned to apply himself with decided advantage.

The patient gave us the benefit of his most conscientious cooperation throughout the long duration of the treatment, and his patience, courage and willingness to help us were most admirable and inspired us constantly in our efforts to improve his unfortunate condition. During the two years that he remained at the hospital he was subjected to six operations. He became attached to the service and rendered most valuable

Fig. 4.—Second stage of Jäsche's operation. Two semilunar flaps are dissected from the cheek on each side of the oral cleft. These flaps remain attached to the gums and alveolar borders on each side of the cleft; the free edges are turned down from the cheek.

help as an assistant nurse, and in this way we were given a most favorable opportunity to follow his progress and the effects of treatment.

On May 30, nearly five months after the division of the cheeks and separation of the jaws, the patient had made so much progress and was able to take nourishment so well and masticate all foods that we decided to complete Jäsche's operation by finally closing the gap in the cheek and restoring the mouth to its normal dimensions. This operation was performed under chloroform anesthesia May 30. Chloroform was given on this occasion because there was no longer the risk

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that was associated with the administration of a general anesthetic in a case of constricted and trismic jaws. Had we given a general anesthetic when the jaws were locked, and had vomiting, extreme salivation or bronchorrhea occurred, the patient would have incurred great risk of suffocation and death from a blocking of the larynx before we could have been able to divide the cicatrices and open the mouth. The choice of an anesthetic is therefore a matter of more than usual concern in such cases, and the advantages of local anesthesia by infiltration are well worthy of consideration. After the mobility of the lower jaw had been secured the special risks of a general anesthetic were eliminated and we did not hesitate to administer chloroform, which the patient took quickly and well.

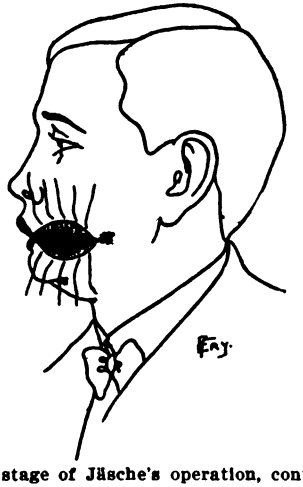

Fig. 5.—Second stage of Jäsche's operation, continued. The diagram shows the free edges of the cheek flaps sutured in the mouth to replace the lost mucosa; the raw surfaces look outward and are subsequently covered by suturing over them the raw edges of the cheek incision.

The second step of Jäsche's operation consisted essentially in cutting two semilunar flaps (Fig. 4) from the upper and lower margins of the buccal cleft, each flap extending at its fixed or attached portion from the angle of the mouth to the end of the newly-formed cheek gap. After dissecting these flaps they were turned into the mouth in such a manner that the epidermal surface faced the interior of the mouth and formed the inner lining of the cheek, the raw surface looking outward (Fig. 5). The fixed edge remained attached to the gums and alveolar processes; the free margins were sutured

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together with fine chromic catgut, thus forming a complete cutaneous partition which replaced the lost mucosa of the cheek, the diaphragm thus formed also acting as a barrier to the secretions of the mouth and preventing their entrance into the cheek wound. The external incision in the cheek was then readily closed by a series of interrupted catgut sutures (Fig. 6). This procedure was successfully applied to both cheeks and the mouth was restored to its normal appearance and dimensions.

The external wound healed per primam and the inverted flaps in the mouth united *in situ* in the right cheek, but the flaps of the left side sloughed away, in consequence, no doubt, of the defective vascular supply which held it to the gums notwithstanding the long time that had been allowed

Fig. 6.—Jäsche's operation completed. The incision in the cheek closed by suture.

to form nutritive communications (five months). This liability to necrosis of the flaps is no doubt the weak point in Jäsche's method of meloplasty in cases of this kind, when the flaps are cut off from the chief base of vascular supply and the nutrition of the skin is dependent solely on adhesions recently contracted with a cicatricial and poorly nourished base, such as usually exist in the scar tissue of the gums. In consequence of this unfortunate loss of the skin flaps on one side a secondary cicatricial contracture inevitably followed, and with it a partial relapse to the original condition of constriction that compelled us to resort to other expedients for the patient's relief.

From May 30, 1901, to Feb. 22, 1902, nothing further was done. The mouth and cheeks had healed completely and the

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patient was able to separate the jaws to some extent, but not more than half an inch in a vertical direction between the front teeth; the lateral motion remained improved, but was still greatly limited on account of the marked contraction of the left inner cheek, which had returned nearly to the condition existing prior to the Jäsche operation.

Therefore, in February, 1902, we decided that before undertaking any further plastic work with the view of correcting the remaining cicatricial contraction in the left cheek, we would increase the general mobility of the lower jaw by excising the right condyle and a part of the ascending ramus, leaving the coronoid attachment of the temporal muscle intact, thus making more space for the play of this muscle and the masseter, which were irremediably atrophied and shortened by early interference with the development and function of the maxilla.

The right temporomaxillary joint was excised and a large section of the ascending ramus of the jaw was also removed subperiosteally, leaving a considerable gap in the bone, which shortened the distance between the zygomatic arch and angle of the jaw on that side, thus approximating the points of attachment of the masseter and temporal without interfering with the periosteal attachment of the pterygoids. This wound healed kindly and without bad effects, as the branches of the facial nerve had been carefully protected throughout the operation. On the other hand, very little benefit was appreciable as far as the mobility of the jaw was concerned in view of the persistence of the cicatricial contraction of the left cheek, which prevented any exhibition of improved motion. Nevertheless, I have reason to believe that the extensive resection of bone at this point has been of value in favoring an increased mobility of the jaw by combining it with the procedures that were subsequently applied.

After this wound had healed we waited until April 21 before proceeding to the final operations by which we expected to completely mobilize the jaw. April 21 (two months after the excision of the right condyle), under chloroform anesthesia, we again divided the left cheek along the line of the old cicatrix and at once a very fair separation of the jaws occurred, which gave us a gain of at least one and a half inches in the space between the front teeth. Fearing now that in spite of the splicing of a new and pediculated skin flap in the cheek that secondary contraction would take place, we decided to create a pseudarthrosis at the left angle of the lower jaw by excising a wedge-shaped piece of the maxilla at this point. This was done by Esmarch's method modified as follows: A horizontal incision about 2½ inches long was made parallel with the horizontal ramus of the jaw and terminating at the angle, around which it curved upward, gently following its

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contour. All the soft parts were cut down to the periosteum, and the angle of the jaw was divided subperiosteally without disturbing the tendinous attachments of the masseter or pterygoid. The angle of the jaw was completely separated from the rami in two sections, one vertical, through the horizontal ramus, and the other a cross section through the ascending ramus, by passing a Gigli saw subperiosteally around the jaw at these points. The periosteal capsule was then divided at this point and the severed bone sections were separately covered with periosteum. This procedure not only protected the exposed bone surfaces, but effectively prevented a future restoration of the continuity of the jaw at this point, the musculo-aponeurotic expansions of the masseter and the external pterygoid being sutured together in the interspace between the divided bone surface. The effect of this newly-created point of motion in increasing the general mobility of the lower jaw was very marked indeed, and we felt confident that if we could only succeed in preventing the formation of a retractile cicatrix in

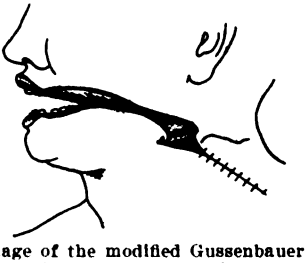

Fig. 7.—First stage of the modified Gussenbauer operation. The skin flap from the neck is turned into the oral cleft so that the skin edge is sutured to the inner raw surface of the cleft corresponding to the upper lip; the raw surface of the flap is also allowed to contract adhesions with the gum and cheek of the upper side of the cleft. After vascular connections have been formed the flap is turned completely into the mouth, as shown in Fig. 8.

the mouth that a permanent and satisfactory mobilization of the jaw would be obtained. Therefore, at the same sitting we undertook a plastic restoration of the cheek somewhat like the method suggested first by C. Gussenbauer in 1877, by which a long, well-nourished, pediculated skin flap dissected from the hairless part of the neck is transplanted into the mouth as a lining for the cheek. A flap 3½ inches in length by 1¼ inches in breadth was dissected from the neck and freely mobilized with its pedicle attached to the face close to the terminus of the gap in the cheek. The flap was turned on itself, and its entire edge was sutured to the inner surface of the vestibule from the angle of the mouth and along the inner border of the upper cheek flap. The lower edge of the transplanted flap was not sutured to the inner surface of the

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lower half of the cheek and the raw surface of the pediculated flap was thus allowed to come in contact with the thick raw surface of the upper half of the cheek (Fig. 7). Nothing further was done to close the gap in the mouth and this stage of the meloplasty was ended by simply closing the wound left in the neck after the transplantation of the pediculated graft.

The division of this plastic operation in two stages was adopted in this case because we were anxious to avoid the risk of a second failure from sloughing, owing to defective vascular connections in the gums and mouth; we feared that in spite of the apparently abundant blood supply that came to the transplanted flap through its pedicle, that necrosis of its edges might occur from partial strangulation and infection if the flap was sutured in the mouth and the cheek closed over it. As a result of these precautions we had the satisfaction of seeing the transplanted flaps firmly united along the

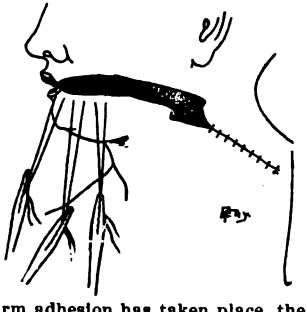

Fig. 8.—After firm adhesion has taken place, the transplanted flap is partially detached from the upper edge of the cheek cleft, leaving the gum line attached. The dermal surface of the flap looks into the mouth; the raw surface of the lower edge is brought into apposition with the raw inner surface of the lower cheek cleft. The two raw surfaces (of the cheek and of the flap) are brought together by a series of transfixion sutures (mattress type), which are tied externally over small pads of gauze.

entire line of attachment to the inner surface of the cheek, where it remained in a well-nourished condition for the following six months. It was not until Nov. 22, 1902, that we undertook the final closure of the gap in the cheek, and this was done as follows:

The transplanted flap which had become firmly adherent throughout its attachment to the intrabuccal surface of the inner cheek was carefully detached from the cutaneous margin of the cheek cleft, leaving the upper skin surface of the graft attached to the gum and vestibule of the mouth. The lower half of the original skin incision was detached from the gum line and the lower border of the graft was inserted in the

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gingivobuccal groove and held firmly in place by a series of through-and-through mattress sutures, which held the raw surfaces of the graft and inner raw surface of the cheek in apposition (Fig. 8). The sutures (silkworm) were inserted with the Reverdin needle and the free ends of each suture were tied over a small pad of gauze on the outer surface of the cheek. After thus securing a complete apposition of the raw surfaces the cutaneous covering of the graft made a smooth lining for the inner surface of the cheek. The external incision in the cheek was closed over the graft by interrupted silkworm sutures throughout its length, except at its terminal (masseteric) end, where the pedicle of the graft was allowed to remain undivided, so as to insure its nutrition until a firm union had been obtained (Fig. 9).

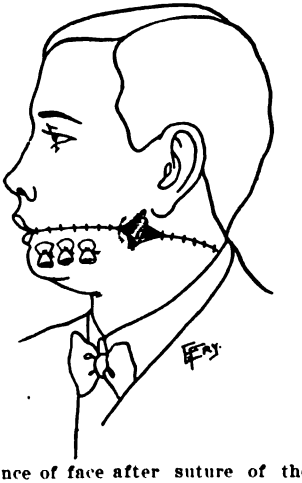

Fig. 9.—Appearance of face after suture of the cheeks in the modified Gussenbauer operation performed in this case. After suturing the cheek the pedicle alone remains to indicate the existence of the dermal flap, which has been transplanted from the neck into the mouth to replace the lost mucosa.

Dec. 8, 1902, seventeen days after the cheek had been closed and no further doubt existed as to the vitality of the transplanted flap, and the success of the operation had been assured by the complete healing of the entire wound, we cocainized the pedicle and excised it, leaving a space at the terminus of the cheek incision, which was closed with a few catgut sutures. On the third day the wound had healed and the patient was well.

The patient remained in the hospital of his own accord until Jan. 8, 1903, when he was finally discharged to return home (Fig. 10).

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Briefly summarizing the operative treatment of this case, we find that the patient was under observation at the hospital for a period of two years, from Jan. 15,

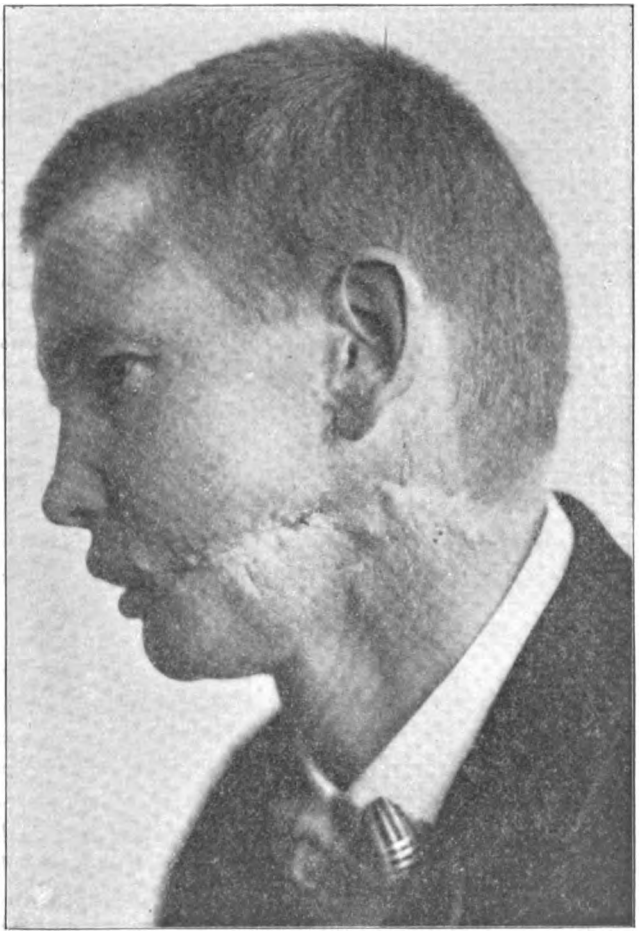

Fig. 10.—Photograph of the patient at the time of discharge from hospital. The pedicle had been divided and all incisions had healed.

1901, to Jan. 8, 1903, and that during this time six operations were performed. The first operation (Feb.

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1, 1901) was a complete through-and-through section of each cheek, including the division and incision of all cicatricial and ossified bands; separation of the jaws and suturing of the skin of the cheek to the gums, thus creating a huge oral cleft, or macrostoma (Figs. 1-3).

Second operation (May 30, 1901): Closure of the cheek gap by Jäsche's meloplasty. Third operation (Feb. 22, 1902): Excision of right condyle and part of ramus of the jaw. Fourth operation (April 31, 1902): Esmarch's cuneiform excision of the left angle of the lower jaw, to create a pseudarthrosis at this point; also first stage of modified Gussenbauer's meloplasty. Fifth operation (Nov. 20, 1902); Gussenbauer's meloplasty completed by leaving pediculated neck graft in the mouth. Sixth operation (Dec. 8, 1902): Division of the pedicle of the transplanted flap and final closure of the cheek incision.

The final results obtained by these various operations and the protracted treatment associated with them was fairly satisfactory, and justified the sacrifices made by the patient in obtaining relief for what appeared in the start to be an absolutely irremediable condition. The chief object aimed at was to restore to the patient the ability to open his mouth, eat and chew food by increasing the capacity of the mouth and restoring the lost motion of the lower jaw. This object was to a large extent attained without entailing any serious sacrifice of his appearance, which had already been seriously affected by the disease. When he was admitted to the hospital the front teeth could not be separated to the extent of admitting the blade of a penknife introduced flatwise. When he was discharged he could separate his front teeth more than an inch apart. He could move his jaws laterally quite freely, and could eat and chew any ordinary article of diet without difficulty. While freely recognizing that all facial scars should be avoided in correcting deformities of this

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kind, it is evident that when dealing with a case of this type cosmetic considerations must be relegated to a secondary plane, and that restoration of the lost maxillary function must be given the prime consideration.

DISCUSSION.

DR. JOHN B. MURPHY, Chicago—This condition of ankylosis is a most trying one for the patient and for the surgeon. I have had the good fortune to have two of these cases. One of them was the result of ulcerative stomatitis, which destroyed all the tissues of the cheek except the skin. The cheek was one cicatricial mass, and the muscles were destroyed clear back to the angle of the jaw. The treatment consisted of division of the fibrous mass and excision of the scar tissue on each side up to the base of the teeth. The first thing that was done after making the incision through the growth was the complete removal of the cicatricial tissue through the mouth. A flap was turned back from the neck below the chin, with its base below the ear. It was drawn into the mouth through a small incision in the cheek at the angle of the jaw, then turned on itself so that the skin came against the teeth and the raw surface outward. It was sutured above and below to the gums and iodoform gauze packed between the teeth and the flap, so as to make a perfect apposition between the cheek and the surface of the flap, thus placing the cutaneous surface of the flap on the inside. The result was excellent and without much disfigurement.

The second case followed the removal of a large angioma, which had left a large cicatricial mass so firm as to displace the teeth inward in a straight line. The teeth stood in a straight row from the angle of the left jaw to the right bicuspid. Through an incision from the angle of the mouth to the angle of the jaw I removed all the cicatricial tissue except the skin. Portions of the angioma still remained. I made the reverse type of flap from the skin of the neck, sutured the edges to the gums and closed the incision in the mouth; the cheek was packed with iodoform gauze. I succeeded in this last case, which I considered the more desperate, in getting a very movable jaw.

In neither case did we have the pain and other complications preceding the operation which Dr. Matas had in his cases, and I desire to compliment him on his work on these cases.

DR. J. R. EASTMAN, Indianapolis—I have had under my observation during the winter, a case of cicatricial ankylosis of the jaw which may be interesting to the members of the Section because of its rather unusual etiology. The case concerned a boy 7 years of age, who gave a negative anamnesis ex-

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cept that he recalled having fallen and having sustained what was described by his parents to have been a slight superficial injury at the angle of the right inferior maxilla. It was impossible for the boy to separate the jaws more than one-sixteenth of an inch, and he was therefore unable to take any other than liquid nourishment. It was also impossible to force open the mouth without using dangerous force.

There was a small scar and reddened area at the angle of the jaw. On making an incision over this scar and passing my finger along the ramus of the inferior maxilla I came on a hard object which proved to be a piece of wood one and one-fourth inches in length by one-fourth of an inch in thickness, jammed in between the ramus of the inferior maxillary and the superior maxillary bone. It was imbedded in scar and granulation tissue, which had become very dense. I removed the wood with a pair of forceps, and was immediately able to open the boy's mouth with slight force as wide as one-half inch. He has been able to chew food of all kinds, and I have not at this time advised further operation, though I am not unmindful that scar formation may make a plastic operation necessary.

Dr. E. D. Martin, New Orleans—The last case recalls one of a severe head injury, where pus had dissected down on either side of the scalp until the masseter muscles were seriously impaired and cicatricial contraction followed. This case I was enabled to cure by a very simple device. I had made for him an apparatus resembling a glove-stretcher. This he carried in his pocket, and in his odd moments would put it between his teeth and with a little force succeeded finally in stretching his jaws to their full capacity.

If I had a case so complicated as the one reported by Dr. Matas I should not hesitate to remove the lower jaw. We know how satisfactory the results are in cases where the jaw is removed for sarcoma, and especially when a temporary splint has been kept in position until the wound has cicatricized. This would preserve the orbicular muscles and give, in my opinion, far better control of the normal structures.

Dr. A. J. Ochsner, Chicago—I wish to call attention in connection with this discussion to one point which became apparent to me in one of my own cases. It is this: that a deformity of the lower jaw, and especially of the teeth such as that encountered in Dr. Matas' case, will disappear to a very great extent in growing children, if the operation is performed while the child is young. In an operation which I did on a child six years ago, within a year the lower jaw grew and the new teeth came in properly and the appearance of the child is now very nearly normal. I think it is better to do the operation while the child is still young, because the deformity can be corrected to a considerable extent, provided the jaw and

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the teeth are not hampered in their growth by the pressure which is due to connective tissue.

Dr. Rudolph Matas, New Orleans—There is no doubt of the great value of plastic flaps in operations of this character as substitutes for the lost mucosa of the mouth, though their value has been doubted by some writers. Without the skin, which is fortunately quite available in the vicinity of the mouth, there would be no hope of ever restoring the mobility of the jaws in grave cases of this cicatricial type. The cheeks, forehead or neck offer the best material for skin transplantation. The skin ultimately assumes the characters of the mucosa, especially when borrowed from normal hairless parts. I am much pleased that Dr. Murphy's experience has confirmed my own. Dr. Eastman and Dr. Martin have recorded interesting cases. Dr. Martin's mode of separating the jaws is valuable, but not applicable to cases like the one under consideration. His suggestion that the removal of the jaw would be expedient in a case like the one reported is entirely too drastic. It is impossible to conceive how excision could in any way better the situation of such a patient. There is no question that my patient's condition is infinitely better now with a plastic that yields restricted motion than without a lower jaw, or with an artificial jaw, as an artificial jaw, no matter how ingenious it might be, could never take the place of even a fragment of healthy maxilla. I entirely agree with Dr. Ochsner's remark that these cases should be operated on early to obtain the best results. I did not see my patient until he was 27 years of age, when permanent atrophic change in the bones and muscles had taken place and when developmental defects in the eruption of the permanent teeth had made the task of a perfect restoration a practical impossibility. Had the operation been performed twenty-five years before, I am confident very little traumatism would have been required to effect a cure. Nevertheless, when we consider the extreme conditions under which treatment was undertaken, the results must be considered highly satisfactory.

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THE SUBCUTANEOUS INJECTION OF PARAFFIN FOR THE CORRECTION OF DEFORMITIES OF THE NOSE.

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The surgical use of paraffin as a prosthetic measure is a recent advancement in the surgical art and consequently is in a more or less experimental stage of development. The first instance in which it was used in an attempt to remedy a defect in the human anatomy dates back but a few years, and while the number of cases in the literature is increasing rapidly, they are still so few in number that every operation of this character should be reported. It is only by a careful classification and study of a large number of cases that we may be enabled to arrive at a definite conclusion as to the merits and demerits of the method, as a recognized surgical procedure.

The attempts at improvement which terminate unsatisfactorily are of even more import than are the cases which result favorably. The temptation is to report the successful operations and to postpone indefinitely a report of those cases which had an unfavorable outcome, in this way giving to the one searching for a verdict on the method, a biased conception as to the results one may reasonably anticipate.

The satisfactory results are sufficient evidence in themselves. The failures demand further attention and investigation both from the operator and the profession

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at large, in an attempt to discover the cause of the fault, and to place it at the door of the method, or of the one who employs the method.

The report of disastrous results should not be confined to the lay press but should appear at length in the medical press, and in this way tend toward the prevention of a repetition of the failure. Not long ago the daily papers, through a press dispatch from Paris, called attention to the case of a young girl who, not satisfied with the appearance of her nose, submitted to an operation in which paraffin was injected subcutaneously to replace a defect, as a result necrosis ensued and the loss of the entire nasal organ was threatened.

Cases such as this demand the most careful scrutiny on the part of the profession before an attempt at a decision as to the value of the new method can be made, and these cases should be brought to the attention of the profession by the one who had the case in charge.

THE ORIGIN OF THE METHOD.

The subcutaneous injection of oils and liquid paraffin dates back almost to the origin of the hypodermic needle and syringe; especially has it been used in the treatment of syphilis, as a vehicle for the suspension of insoluble medicaments. Corning in 1891 presented an article entitled, "Localization of Remedies About the Sensory Nerves of the Skin," in which we find the first use of a solidifying oil in surgery. As the title implies, the object of this method was to fix medicament, usually an analgesic, in a particular neighborhood by the injection of the oil immediately after, and through the same needle, and then by a cold application, or the refrigerant spray, the oil was solidified, and the absorption or dissemination of the drug prevented.

In 1894 Corning enlarged the application of this subcutaneous injection of paraffin, by its injection into a muscle for the arrest of spasm. This was accomplished with a satisfactory result and the name "Eleomyenchysis" applied to the procedure. The same investi-

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gator, in 1896, utilized this substance in still another manner. After the subcutaneous division of a nerve for neuralgia, paraffin was inserted between the two divided ends, and then solidified by the external application of cold. Regeneration of the nerve ends and the return of pain were in this manner prevented.

The *Medical Record,* in an editorial on this phase of the subject, concludes as follows: "It is clear that the credit for the idea of the mechanical employment of oils in the tissues belongs wholly to Dr. Corning. And not only is he entitled to the honor of originating the principle, but also to credit for developing a method far more scientific than that of any of his followers."

From a survey of the available literature it would seem positively proven that, as quoted above, the principle of the subcutaneous injection of paraffin was first utilized by Corning, but also that Gersuny in his article of 1900 entitled, "Ueber eine Subcutane Prosthese," was undoubtedly the first to recommend the use of, and to use, paraffin, subcutaneously, as a prosthetic measure.

The fact that paraffin or vaselin can be sterilized, made to melt at a given temperature, and when injected under the skin, will give rise to no untoward symptoms, no toxic absorption, no marked inflammatory reaction, and no pain or discomfort, but instead serve as a non-irritating framework which acts as a support of newly formed connective tissue—these facts form the basis, the foundation of all that has been done with paraffin as a prosthetic substance during the past few years, and it would seem that this was first brought out by Corning of New York, and then re-emphasized and enlarged by Gersuny of Vienna, so much so that the procedure is commonly known as "Gersuny's Method."

The writings of Gersuny and his assistants have led surgeons throughout the land to utilize this substance in efforts to repair, or improve on, defects in the human anatomy. These defects have been of a great variety and include almost every possible sort of deficiency,

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defect or blemish which human flesh and bone is heir to. The first instance in which it was used in the human body was for the formation of artificial testicles in a person who had been castrated for tuberculosis of those organs. This was successfully accomplished by Gersuny in 1899, and at the last report, after the elapse of over three years, the artificial testicles were in perfect condition, and, to the palpating fingers, felt like cartilaginous masses. This, notwithstanding the fact that the patient had passed through a severe attack of typhoid fever, his temperature rising to 40 C. (104 F.). At the time of this high temperature, the masses of paraffin within the scrotum were noted as becoming a little softer, but after the decline of the temperature, they returned to their former consistency.

FIELD OF EMPLOYMENT.

Among the other conditions in which this method has been employed might be mentioned inguinal and umbilical hernia, incontinence of urine, incontinence of feces, prolapse of rectum, prolapsus ani of children, prolapse of uterus, displacement of uterus, cleft palate, partial and complete, prevention of post-operative adhesions, obliteration of scars resulting from accident, obliteration of scars resulting from mastoid or frontal sinus operation, obliteration of scars resulting from confluent smallpox, to restore the symmetry of the face in facial hemiatrophy, to restore the symmetry of the face after the removal of maxillæ, as a foundation for an artificial eye, to repair the defect after resection of the ribs, to prevent ankylosis of joints after resection, to prevent regeneration of nerves after resection and the formation of artificial turbinated bones.

The above are among the more usual indications for the employment of this method; while the most frequent defects for which the subcutaneous injection of paraffin has been resorted to, if one may judge from the literature, are deformities of the nose.

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It would also seem, from the literature, that in but one deformity of the nose has repair been attempted by this procedure. That is the "saddle-back" nose. This may be, and in all probability is because it is by far the most common deformity of the nose, in which there exists a defect which may be filled in. Of course in that variety of malformation in which there is an increase of tissue, this method will, as a general proposition, be contraindicated.

CLASSIFICATION OF NASAL DEFORMITIES.

Roe has classified nasal deformities as follows:

Deformities of the nose	Bony portion	Vertical	Convex.
			Concave.
		Lateral	Spatulated.
			Deflected.
	Cartilaginous portion	Tip	Excessive or deficient tissue.
			Deviation from median line.
		Wings	Collapsed.
			Expanded.

From this classification, it will be seen that in a fair proportion of the various deformities it is both practical and possible to remedy the defect by the subcutaneous injection of paraffin; and not only remedy the defect, but in addition, do so in a manner much better and more rapidly, and with considerable less inconvenience, to both operator and patient, than by means of any other known method at our disposal for the remedy or improvement of such condition.

The most satisfactory results, the extreme simplicity of the procedure, and the rapidity with which the irregularity is corrected are all more pronounced when compared or contrasted with the more unsatisfactory, complicated, and time-consuming (both to the patient and the operator) methods previously advocated, such as the so-called plastic operations, and in the methods which include the insertion of a foreign substance such as metal, celluloid, or ivory plates or strips.

Of those deformities included in Roe's classifications, the concave vertical or the saddle-back nose is beyond all doubt the condition *par excellence* for the employment of this procedure.

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Among the other deformities of the bony portion of the nose, this line of treatment is not at all constantly indicated, but cases might arise in which the spatulated or deflected lateral variety of nasal deformity could be made less noticeable, by the use of this foreign body inserted subcutaneously. In the convex vertical, where there is a redundancy of tissue, there seems to be practically no indication for its use.

As to the cartilaginous portion, when the tip is deficient in size, this method will be again found to be available in improving the appearance of the organ. When of excessive size, and when deviated from the median line, there is little, if anything, to be gained by using the method under discussion. When the wings are collapsed we have found the method satisfactory in causing the alæ to resume their relatively normal position and appearance. And with the wings expanded, it is again found to be of no practical value. This review of the possibilities of the procedure will show a very wide field for its usefulness, and serve as a satisfactory excuse for its serious consideration.

INDICATIONS.

On account of the character of the work involved, the method must be proven to be absolutely harmless, devoid of any possible danger when properly applied, before it should or can become a recognized surgical procedure. The operations in which this method will be employed are not, as a rule, matters of necessity, and when performed, in an attempt to remedy a slight defect in a person's countenance, a defect often exaggerated in the mind of the patient applying for improvement, one must be reasonably, if not absolutely, certain that this defect will not be, by any chance, made worse than it was originally. Very frequently the irregularity of the face is such that, to an uninterested person, it would seem that the deformity had better be left alone.

The fact that a patient comes to you to have his or her appearance improved on, is certain evidence, or at

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least satisfactory evidence, in the vast majority of instances, that he or she is hypersensitive about the matter, and is more than likely to be dissatisfied with the result of your attempted improvement, even though it be satisfactory from a surgical view point. Such cases differ and should be differentiated from those in which the nature of the defect demands that some measure, operative or otherwise, be taken in order to prevent that person from becoming an object of either pity or ridicule throughout the remainder of his days, if no attempt at improvement is undertaken. In such cases it is always justifiable to make an attempt at improvement of the existing conditions. In another class of cases, those in which the deformity is comparatively trifling, in many instances it is not indicated nor justifiable to operate on them.

THE DIFFICULTIES.

The possible causes of failure, in the latter class of cases especially, should always be most fully and carefully presented to the patient, and then it is for him to decide whether or not to undertake the risks, as there is always a risk associated with the performance of an operation of this character.

These possible sources of failure, and therefore objections to the method, many of them chimerical, some theoretical, and others real and existing, may be enumerated as follows:

1. Toxic absorption.
2. Marked inflammatory reaction.
3. Loss of tissue, due to infection and abscess formation.
4. Pressure necrosis, caused by the injection of too much paraffin.
5. Sloughing of tissue, as a result of the heat of the paraffin.
6. Injection into very dense, or inelastic structures, or where scar tissue is firmly attached to the underlying and adjacent parts.
7. Injection of too small an amount of paraffin, with an insufficient correction of the deformity.
8. Injection of too large an amount of paraffin, with an overcorrection of the original deformity.
9. Air embolism.

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10. Paraffin embolism.
11. Extension of the paraffin, when first introduced, into adjacent normal structures, such as the infraorbital region.
12. Interference with the muscular action of the nose.
13. Escape of the liquid paraffin, after the withdrawal of the needle.
14. Solidification of the paraffin in the needle, which renders the injection difficult, and causes injudicious expedition on the part of the operator.
15. Absorption or disintegration of the paraffin.
16. The difficulty of procuring paraffin with the proper melting point.
17. A resultant hypersensitiveness of the skin over the injected area.
18. A marked and more or less permanent redness of the skin over the injected area.

These, the more important objections, will be taken up seriatim and considered more or less at length, as may be required in each instance.

INTOXICATION.

1. The danger of an intoxication due to the absorption of paraffin was one of the first objections raised against the method; but it is now generally conceded that when such symptoms occur they are due to some impurity of the substance injected. Meyer was the first to emphasize this objectionable point, and his position was corroborated by the animal experiments of Straume, Dunbar, Stubenrath, and Sobieranski. These men injected paraffin in the lower animals, and for some reason procured a decided constitutional reaction, which they attributed to the toxic qualities of the foreign substance.

On the other hand, the experiments of Stein and of Smith demonstrate that this injection may be, and in their experience was, followed by no reaction, either constitutional or local. Jukuff made similar experiments, and concludes that the amount of paraffin injected subcutaneously, necessary to produce toxic symptoms, must be equivalent to 10 per cent. of the body weight of the animal into which it is injected. Granting the accuracy of his experiments, it would place the dangerous amount in the neighborhood of from ten

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to fifteen pounds, a quantity greatly in excess of the maximum dose employed in prosthetic surgery. These latter experiments, with the more convincing and constantly increasing number of satisfactory cases on the human being, have led to the belief that the experiments first cited were imperfect in some respect, either in an impurity of the injected substance or some error in the technic employed, and that there is no danger of any toxic absorption in the method.

REACTION.

2. A mild transitory inflammatory reaction usually occurs after the injection. A marked inflammatory reaction has been noted in but very few of the reported cases, and in these was usually due to avoidable and extraneous causes. The mild reaction that does take place before the encapsulation occurs is seldom of sufficient severity to warrant its being classed as inflammation.

INFECTION AND NECROSIS.

3. Infection followed by abscess formation, and, in consequence, a loss of tissue, can not be reasonably held against the method, but rather against the technic used in employing the method. This danger, infection, is no greater after this procedure than following the ordinary usage of the hypodermic syringe, which in proper and competent hands is practically *nil*.

4. The pressure necrosis that may be caused by the introduction of too large an amount of paraffin, is one of the most dangerous, humiliating and aggravating outcomes that may follow the use of this method, and it undoubtedly has occurred in a certain proportion of the cases. With the surgeon carefully molding the mass with the fingers of the left hand, as the paraffin is being introduced, in this manner being all of the time cognizant of the amount of pressure that is being exerted on the overlying skin, such an accident should rarely, if ever, occur. The circulation should always be perfect over the injected mass immediately after the con-

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clusion of the operation. This can readily be determined by noting the return of the blood to this area after a local ischemia has been produced by digital pressure.

5. Sloughing of the skin has been noticed in cases where the harder paraffins have been used—those with a high melting point (59 to 65 C., 136 to 149 F). This is one of the objections raised to the use of the harder paraffins by those who employ that with a lower melting point. It is not rational to presume that such an occurrence would take place after the injection of paraffin with a melting point of 110 F.

6. In cases where the tissue covering the defect is very firmly attached to the underlying structures, and when it is necessary to inject into a very dense and inelastic tissue, the danger of sloughing is considerably greater. In order to reduce this danger, under the first circumstance it is advisable to detach the cicatricial tissue in some manner, before the injection, preferably by means of a subcutaneous incision. In the latter instance, it has been recommended that the injection of the paraffin be preceded by the injection of Schleich's solution into the area that the paraffin is to occupy. This would serve the double purpose of anesthetization and of dilating the tissue in preparation for the paraffin soon to follow.

Injection into this class of tissues was not originally intended, and is not to be enthusiastically recommended, even though a number of instances in which it has been successfully carried out have been reported.

ERRORS OF TECHNIC.

7 and 8. The introduction of too large or too small an amount of the substance is an error of technic and within the control of the operator. The latter is a comparatively slight fault, if one at all, and can be easily remedied by a subsequent injection. It is, indeed, a preferable manner of dealing with these conditions. It has been recommended that we make numerous injections of a small amount each time, instead of attempting to

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remedy the entire defect at a single sitting. In this way one obviates the danger of making too large an injection. Freeman has noted a confusing amount of edema occurring very rapidly, which makes it sometimes dffiicult to accurately estimate the amount of paraffin needed; at a second step of the operation the further requirements can be more accurately determined. Other advantages of this operating in stages are that, at the second sitting, there exists a more substantial basis to work on, i. e., the previously injected material. The skin is given an opportunity to gradually stretch and accommodate itself to the new state of affairs without any undue or hazardous tension.

The introduction of too large an amount of paraffin is an extremely difficult matter to remedy, hence great care should be exercised in attempting to prevent such an occurrence. The best treatment of this condition is prophylactic, i. e., as cited above, numerous injections of small amounts in preference to single injections intended to remedy the entire fault. Paraffin, while soluble in a number of substances, such as ether, chloroform, xylol, benzine, etc., can not be acted on by these through the skin.

Smith reports one case in which it was necessary to remove some of the injected paraffin. He made a subcutaneous opening and endeavored to curette some of it away, but found that it had become so intimately embedded in the tissue that it was impossible to remove it without removing a large amount of newly formed connective tissue as well.

EMBOLISM.

9. Air embolism is a very slight danger in all cases in which a subcutaneous injection is made, but can be readily excluded by taking the precaution to expel all the air in the needle and syringe before introducing the needle beneath the skin—the same as is done every day before hypodermic injections are made, i. e., hold the syringe erect, allow the air to come to the top, and then

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press on the piston till the air is forced out and the fluid escapes at the tip of the needle. But that this danger of air embolism is greatly exaggerated can be readily seen by referring to the experimental works of Senn and of Hare and also by the absence of symptoms of air embolism, after hasty and careless subcutaneous injections.

10. The introduction of paraffin into a vein, either directly or indirectly, and lung embolism as a result, is one of the most serious and consistent of the objections which have been raised against this line of treatment. Consistent, in that such cases have been reported by Pfannenstiel, Leiser and others, showing that the objection is not without foundation in fact. It is a fault which bears with equal force in any method of subcutaneous injection of a solid, semisolid or liquid, insoluble substance.

In Pfannenstiel's case, in which there was injected 30 c.c. of paraffin at the melting point of 45 C. (113 F.), the injection was followed by the typical symptoms of embolism, as described by the syphilographers, that has followed the injection of mercurials in oil, such as cough, chill, headache, vomiting, increased respiration and later dyspnea and cyanosis. The symptoms are usually very mild, death very rarely, if ever, occurring from this cause alone. In Pfannenstiel's case, the symptoms persisted for about one week and then gradually subsided with recovery of the patient.

Attention has been called, in this connection, to the experience of the dermatologists, with embolism after the injection of mercurial preparations suspended in liquid oils or paraffins. And from a review of the literature on that subject it would seem that embolism is far more likely to follow the parenchymatous than the subcutaneous injection, but in neither is it absolutely excluded, but apparently present in a small percentage of all the cases so treated.

This radical difference is to be noted between the in-

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jection of the liquid oil, as is done in treating syphilis, and the method under consideration. In the former the substance is in a fluid state, therefore absorption and emboli are more likely to occur than in the latter, where the injected substance is semisolid. With the injection of paraffin that emerges from the needle, as a worm-like string, and not in a fluid state, it seems that the danger of embolism may be very materially diminished, if not excluded. Comstock says: "In all cases in which paraffin was used at 102 F. the animals died within two weeks' time, hence the specimens at that temperature are limited (death being caused by thrombosis). . . . In all other cases, with the higher melting point, 110 F., no unpleasant results were experienced whatever."

Explanations of the accident in Pfannenstiel's case have been offered, such as: The temperature of the paraffin was too high, consequently it was injected hot and liquid, thus favoring absorption; or, the high temperature caused a coagulation of the blood in the veins, in this manner favoring the occurrence of thrombosis and embolism. Again, it has been said that so large an amount of paraffin, at so low a temperature, could not possibly harden when under the skin for some little time after the operation, and in this way make possible the occurrence of absorption and embolism. Other explanations are: That the injection was made parenchymatously instead of subcutaneously; that the injection might have been made directly into a vein.

For the prevention of embolism, it has been recommended that the injection be made into the subcutaneous tissue only and never into the parenchyma and that paraffin be utilized that has a melting point neither too high nor too low, this being best determined by seeing that the paraffin emerges from the needle, at the room temperature, in a worm-like string.

Stein says that all that is necessary to avoid pulmonary embolism is to avoid the pricking of a vein, and recommends that only subcutaneous injections be made,

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and that the needle be first inserted, and only after it has been demonstrated that no blood flows through it, should the syringe be attached.

Freeman says: "This danger may, perhaps, be avoided by using a blunt-pointed needle, after having first punctured the skin with a sharp one."

Paget advocates the application of a firm and close pressure all around the nose during the injection. Jukuff of Strausburg found unfavorable or fatal results experimentally, after the injection of over one-tenth of the body weight of the animal, or when the injected paraffin had a melting point below the temperature of the body. In the later instance, the autopsy invariably disclosed thrombosis in many of the smaller veins, and embolism of the lungs. Comstock concludes that paraffin must be used where it will be at all times above the temperature of the body, in order to prevent any danger from embolism.

UNDUE SPREADING OF THE PARAFFIN.

11. The paraffin, when first introduced under the skin, may extend to regions of the face that are normal, and not in need of this artificial substance. Such an extension to the loose areolar tissue of the infraorbital regions while injecting for the repair of a saddle-back nose is not uncommon. Such accidents are due to a hyperinjection, and care should be exercised, and only a proper amount of paraffin introduced.

Firm digital pressure around the nose, made by an assistant, may prevent such an occurrence. Paget states that this firm digital pressure may be helped by the use of a strip of lead or pewter beneath the fingers. Downie recommends the use of celloidin, as follows: Fifteen minutes before the injection he paints a band of celloidin (collodion will answer the same purpose) across the nose at the level of the eyes, and down each side of the nose, at the junction with the cheeks; this contracts and helps to prevent the paraffin from passing into the cellular tissue beneath the eyes. Immobility of the parts, and the

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local application of ice or cold, have been advocated as aiding in the more rapid setting of the mass, and in this way preventing its extravasation into undesirable parts.

12. Alter has called attention to a paralysis of the muscular action of the wings of the nose, resulting in impeded nasal respiration. He states that the current of air rushing into and through the nose carries with it an inherent tendency to draw the alæ septalward; this, however, in normal conditions is counteracted by the action of the dilators of the alæ nasi, viz., dilator naris posterior, dilator naris anterior, pyramidalis nasi, and the levator labii superioris alæque nasi. The modus operandi of this interference with the action of these muscles, according to Alter, is by compression, the presence of the paraffin interfering mechanically with their free muscular action, resulting in collapse or inward drawing of the wings of the nose during inspiration. He cites one case in which this interference with inspiration was very marked, after the injection of the paraffin.

As a preventive measure against such an occurrence, he recommends that an assistant make firm pressure on the wings of the nose, by placing a thumb in each nostril, and the making of counter-pressure on the outside with the index finger, this pressure being maintained until the nose has been molded into its proper shape.

13. There is but little danger that any of the paraffin will escape between the time of the withdrawal of the needle and the sealing of the wound puncture with collodion, if it is injected while in a semisolid state, as it should be. But it has been suggested that a piece of gauze soaked in ice water be placed over the nose before the withdrawal of the needle, and so hasten the setting of the paraffin and preventing its escape at the time of the withdrawal of the needle.

THE SYRINGE TO BE EMPLOYED.

14. Another annoying feature is the setting or the solidification of the paraffin in the needle before the injection is made, necessitating undue haste in the opera-

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tion or great difficulty and force in the injection. To obviate this it has been recommended that the syringe be kept in a receptacle of hot water after being filled and until ready for use; or, a fine wire, such as is to be found in hypodermic cases, may be inserted into the needle to remove the obstruction. Downie winds the outside of the needle with a fine platinum wire, which is then kept hot by being connected with a storage battery. Eckstein places a rubber tubing over the syringe to keep in the heat. Karewski of Berlin has invented a syringe for this purpose, surrounded by a jacket through which circulates a continuous current of hot water.

In the writer's opinion, the best method to prevent this aggravating delay in the technic is by the employment of a syringe similar to the one described by Smith, and also used by Leonard Freeman, i. e., one in which the piston rod is surrounded by a coarse screw worm, and fitted on this rod is a metal thumb screw, which runs up and down, and is made to screw into the upper end of the cylinder of the syringe, at the volition of the operator. When the thumb screw is not fitted into the cylinder the piston works up and down, as in an ordinary syringe, and any liquid can be drawn up and expelled readily by manipulation of the piston; but when the thumb screw is put into place it becomes necessary to screw the piston down, and by so doing the paraffin is slowly and evenly ejected from the needle. By using a syringe of this character the necessity of an embarrassing haste and of a force, hard to apply, is dispensed with.

Before becoming familiar with the construction of such a special syringe the writer had improvised one by using the ordinary syringe with a screw worm on the piston rod, and on this screw a plate, which can be made to run up and down the piston rod. By a simple mechanism this nut or plate was fixed in place at the top of the cylinder of the syringe so that it could not turn. By screwing the piston rod we arrived at the same result as is achieved by the special syringe; that is, a uni-

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form and steady pressure, with an equal and even advance of the paraffin, resulting in a regular and continuous, smooth emptying of the barrel of the syringe.

ABSORPTION OF THE PARAFFIN.

15. The point has been raised that the paraffin will serve as a temporary support only and soon disappear; that it will become absorbed or disintegrated. According to Gersuny, the mass of paraffin is not taken up by the lymphatics, but remains as an inert non-irritating body which soon becomes encapsulated and is subdivided by an ingrowth of newly formed connective tissue; the mass of paraffin finally becomes very finely divided and partially emulsified. These finely divided particles of the substance are first seen at the periphery of the mass and finally are absorbed, their place being by this time taken by new connective tissue, which gradually becomes harder, until it closely approaches the consistency of cartilage. This same chain of events has been noted, experimentally, by Juckuff.

This theory as to the ultimate destiny of the paraffin seems to be corroborated, and to coincide with the facts, in Smith's case, in which he endeavored to remove some part of the injected paraffin a number of months after the injection, and found that the greater part of it had become so intimately embedded in the meshes of the newly-formed connective tissue that it was almost impossible to remove the paraffin without also removing considerable of the connective tissue. Regarding this question, Stein believes that it is reabsorbed little by little, and replaced by connective tissue, so that the persistency of the plastic result is assured. And what confirms him in this opinion is that, whatever be the melting point of the paraffin—and it may vary considerably—the consistency of the nodule augments or diminishes by degrees, according to the case, so that at the end of a month or so, it is always perceptibly analogous to cartilage.

Freeman says encapsulation soon takes place, just as

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it does with a bullet or any other foreign body. A limited amount of connective tissue also penetrates the material, which is speedily converted into a solid cartilage-like mass.

Kramer has used melted agar-agar in subcutaneous injection for the production of connective tissue artificially, and has made interesting experiments on animals. On microscopic examination of the substance at different times he finds that the mass of agar at first becomes infiltrated with round cells, and that then these are replaced by vascularized connective tissue.

Comstock presents a most thorough and valuable work on the injection of paraffin, experimentally. He has made a most comprehensive study of the histologic and pathologic changes in the tissues of the body, and of the changes in the substance itself, after varying lengths of time and after the utilization of paraffins having different melting points. His conclusion is as follows: "In paraffin we have a substance that will fill in spaces of lost tissue, and not remain entirely a capsulated foreign body, but become a bridge work and, in fact, a part of the new tissue."

Downie injected some paraffin into a female breast one week prior to the amputation of that structure for malignant disease. After the removal of the breast, sections were made and examined. The paraffin was found in masses of various size located between collections of adipose vesicles, which were displaced by them. He infers that the paraffin had made its way along the lines of connective tissue trabeculæ, between the fat-containing cells. It is difficult for him to believe that the position of the paraffin would subsequently alter, to any extent, although its absorption seems quite possible.

Gersuny's first case was performed in May, 1899, and in the last report of that case, after a lapse of three years, there was noticeable no diminution in the size of the prosthesis.

This, with the other cases and experiments, would

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seem to indicate that if the paraffin is absorbed it is replaced by connective tissue, or if absorbed and not replaced by new tissue, it is absorbed so very slowly as to have no practical bearing on the advisability of operating by this method.

Granting that the prosthesis will gradually become smaller in time, from absorption or any other cause, repeated injections may be made at intervals, as the case may require, with but a small part of the inconvenience to the patient, as that which would accompany any of the so-called plastic operations in vogue before the introduction of the injection method, or, in the majority of cases, with less discomfort than will be associated with the persistency of the original deformity.

PREPARATION OF THE PARAFFIN.

16. To obtain a paraffin that has the proper melting point is something of a time-consuming and tedious procedure. The ordinary soft paraffin has a melting point of about 120 F., and this must be mixed with the white cosmolin, or vaselin, of commerce, which melts at about 100 F. The mixture is heated and its melting point determined by the following procedure, as recommended by Gersuny: The bulb of a clinical thermometer is coated with the mixed paraffins, and placed in a water bath, which is slowly heated until the paraffin melts and floats on the surface of the water; the heat is then removed, and the temperature of the cooling water noted, when the transparent drops of paraffin become opaque once more. If this temperature is not the desired one, the process must be repeated, after a recombination of the two paraffins, with the addition of more soft, if the melting point is too high, or the addition of more hard, if it is too low.

This tedious and objectionable experimenting in order to procure the proper mixture of paraffins has been rendered unnecessary by Dr. Harmon Smith of New York, who has had a paraffin prepared with the proper melting point in sterile sealed test tubes, and for sale in the

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market. It is advisable, as a regular procedure, to re-sterilize this commercial article by heating before using it. The paraffin prepared by Smith has a melting point of 110 F.

This brings us to a discussion of the question as to the proper melting point of paraffin intended for subcutaneous injection. Here we find considerable variance of opinion. Moszkowicz, Gersuny's assistant, states that the paraffin must have a melting point between 36 and 40 C. (97-104 F.). In speaking of Pfannenstiel's case, Moszkowicz said: "He injected paraffin with a melting point of 45 C., which is much too high." Parker utilized a paraffin with a melting point of 102 F. Leonard Freeman uses a paraffin that melts in the neighborhood of 40 C., 104 F. In Downie's cases the melting point varied from 104 to 108 F. Paget at first used a paraffin that melted at 136 F., then later one that melts at 115 F., and still later a mixture that melts at 111 F.

In the vast majority of the instances in which the method has been employed, the melting point has been in the neighborhood of 110 F. A higher melting point has been recommended and advocated strenuously by Eckstein, Karewski and others, the former placing the best point of liquidation between 56 and 58 C. (133 to 136 F.), and the other saying that the melting point should not be below 57 or 60 C. (134 to 140 F.). Paget says: "I am absolutely sure now that Eckstein's paraffin is without any real advantage. It is very difficult to handle, it sets very rapidly, it causes a gread deal of swelling and some inflammation, and may even produce some discoloration of the skin, and it yields no better results then does Pfannenstiel's paraffin, which melts at 115 F."

Comstock, after experimenting on animals with this point in view, says: "Paraffin must be used where it will be at all time above the body temperature." He also says: "In selecting the melting temperature point for surgical uses, allowance will have to be made for the

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difference in temperature between the rabbit and human species, which is about 4 F., making a choice of 106 or 107 F., the best for use in subcutaneous injections, for the reason that it gives a substance firm enough to hold very well its form, especially when confined by the surrounding tissue, and at the same time with a melting point out of the reach of the system at all times."

Some of the objections entered against the use of the harder paraffins are: Difficulty in manipulation at the time of the operation; heat and hardness, which are liable to favor the occurrence of irritation, inflammation or even necrosis; its liquid state at the time of the injection, which makes its localization more difficult and uncertain and which makes the formation of emboli possible. Paget calls attention to the fact that when the paraffin "sets" it shrinks, and the harder the paraffin the greater the shrinkage. Those preferring the use of the harder paraffin reply by stating that the softer mixtures, because of the longer time required for them to set, are more liable to extravasate, are less durable and permanent, and are more liable to form emboli.

Disregarding these theoretical points, from the literature, one must be convinced that the melting point most generally used is one between 105 and 115 F., though satisfactory results are not lacking in which paraffins of a higher melting point have been used.

SENSITIVENESS AND REDNESS OF THE SKIN.

17. A resultant hypersensitiveness of the skin over the injected area is a theoretical objection that has been raised against this method of treatment, but which has not materialized in any of the available reported cases. There has been, in many cases, a slight painfulness, or rather a sense of fulness or distension, for a short time after the operation, and in some few cases a more marked painfulness existed for a longer time, but this invariably soon passes away and the sensation remains perfectly normal in every respect.

18. A redness of the skin over the injected area has

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been noted by many operators, but it has always been transitory in the reports of cases that have come under the writer's observation. Paget says: "In a few cases —but only in a few—some reddening of the skin has followed the injection, and in a very few this has been very slow to fade." These few cases occurred in a series of twenty-two cases, and we are not told whether it occurred more frequently after the injection of the paraffin with the high or the low melting point.

In one of the six injections reported with this small contribution to the subject, it will be found that this redness resulted and has been present for over a year, and during that time has diminished very little.

This resulting redness of the skin is the only objection of the many sources of failure or objections herein cited that I have found existent in my very limited experience.

INSTRUMENTS.

The instruments necessary for the proper performance of this operation are very simple and very few.

A special receptacle for the paraffin, as described by Smith, while convenient, is not essential.

The syringe is the all-important consideration; an all-metal syringe is to be preferred because of the ease with which it may be absolutely sterilized by boiling. One with the screw worm on the piston rod, and on this the thumb screw that can be attached to the barrel of the syringe, is almost invaluable. The size of the syringe is not so very important; that it be not ungainly in the handling is about the only practical limitation. Smith and many others use one with a capacity of about 90 minims, while Downie employs one that will hold 10 c.c. (2.5 3).

The needle should be short and but a little larger in diameter and lumen than is the ordinary hypodermic needle.

TECHNIC.

As regards the technic, that of Gersuny has not been modified to any considerable extent. With the exception

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of the special syringes, the instruments are practically the same. The operation may usually be carried out in the following order: 1, preparation; 2, anesthetic; 3, introduction of the paraffin, and 4, after-treatment.

1. *Preparation.*—The most careful and painstaking antiseptic precautions must be observed. The skin of the nose, cheeks, forehead and chin must be given a thorough scrubbing with soap and water twenty-four hours before the time set for the operation, or better, once forty-eight hours, and then again twenty-four hours before the time set for the injection. The night before a moist dressing should be applied over the proposed site of injection, over this oiled silk, and then a bandage to keep it in place.

Immediately before the operation, with the patient on the table, the skin of the nose and face should be once more cleansed. The patient's head and hair should be covered with a sterile cap and the remainder of the body with a sterile sheet. The operator's and assistant's hands are being rendered surgically clean while the instruments are being boiled and the paraffin is being again sterilized.

2. *Anesthetic.*—A general anesthetic is never absolutely necessary. A local anesthetization of the skin, at the site of the entrance of the needle, is all that is necessary in the great majority of cases. There is a diversity of opinion regarding the use of a general or a local anesthetic in this class of cases. Downie says: "The patient may or may not be anesthetized. In many cases there is a distinct advantage in having the patient under an anesthetic. A local anesthetic is, in my opinion, inadvisable."

On the other hand, there is certainly a distinct advantage in having the patient not under general anesthesia, and in certain cases the use of a local anesthetic is the only way that this is possible. While the dangers of general anesthesia are very small, they are, nevertheless, constantly with us and must be considered. The

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location of the intended insertion of the needle for the injection of the paraffin can be easily anesthetized with a solution of cocain or eucain B., the strength of the solution varying from 1 to 4 per cent., according to different authorities. A 1 per cent. solution was used in all cases by the writer.

Freezing with ethyl chlorid of the site of the future needle puncture may be employed as a preliminary step before the injection of the cocain or as the only local anesthetic, dispensing with the cocain entirely.

In some cases, the injection of the paraffin has been made without any preliminary anesthesia of any kind, either general or local. But the anesthetization of the skin, at the site of the puncture, is advisable, in order to prevent any sudden movement or jerking of the head at the time of the needle prick, which might be the cause of more or less serious damage or inconvenience.

3. *Introduction of the Paraffin.*—The paraffin, having been boiled with the instruments, is now in the fluid state, and is drawn into the syringe—the barrel of the syringe had best be about three-quarters filled. With the ordinary syringe considerable haste is now required in order to make the injection before the paraffin will solidify in the needle of the syringe, so causing great difficulty and force in its removal, and with the probability of irregularities in the mass because of the unevenness of the force applied during the injection. However, with a syringe such as has been described by Smith and by Freeman, this haste is not necessary, the force being applied by means of the screw arrangement, and the result is always even and satisfactory, no matter how long a time may have elapsed between the filling and the emptying of the syringe.

The air being expelled from the syringe, all is ready for the introduction of the paraffin. The skin of the nose is picked up in a fold, and the needle then inserted under the skin. It has been recommended that the skin be incised with a small scalpel, as a preliminary step, and

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then followed by the insertion of the needle, in this way hoping to decrease the pain and the resistance to the passage of the needle. The site of entrance of the needle should be away from the region of the greatest deformity. If a saddle-back nose, the needle is usually made to enter

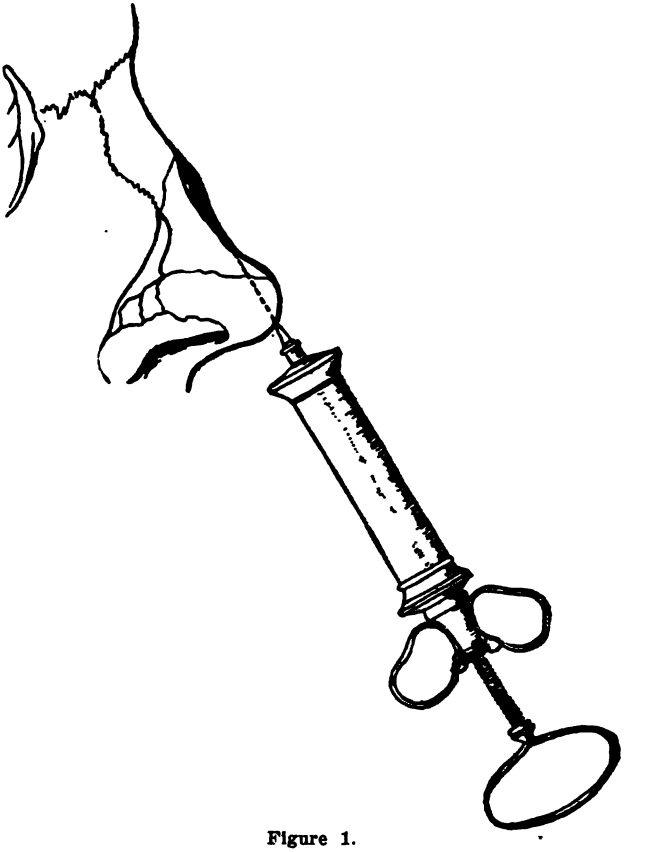

Figure 1.

the skin at about the junction of the nose with the forehead, about on a level with the eyebrows.

Leonard Freeman, and the writer in his cases, have inserted the needle at the tip of the nose, instead of at the apparently more common situation. The chief advantage of this locality over the one more commonly

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used is that it allows more freedom in the manipulation of the point of the needle after it is once under the skin. Freeman says: "The thickened tissues at the tip of the nose prevents the paraffin from diffusing itself along the track of the needle, as is apt to occur in the areolar tissue at the base of the nose."

From either point, the needle is carried along subcutaneously until its extremity is at the most distant point of the deformity, and is then gradually withdrawn, leaving its deposit of paraffin as it recedes (Fig. 1). In this way all parts of the deformity may be reached with but the single puncture of the skin. The remote point of entrance is to prevent, in a way, the escape of the paraffin after the withdrawal of the needle. As the paraffin escapes into the cavity of the defect, the needle is slowly withdrawn, and with the finger of the left hand the operator molds and outlines the freshly deposited paraffin, thus preventing the injection of too large an amount, also preventing its extension into regions where it is not desired, and likewise preventing the occurrence of any lumps or irregularities in the artificial body. A little finger inserted into the nostril will prevent an encroachment on the lumen of the nasal canal.

The needle should be well withdrawn by the time the deformity has been fully corrected, after which the needle is removed through normal skin, in which it leaves no paraffin and the puncture sealed with a collodion and cotton dressing.

It has been recommended that the entire defect be not remedied at one injection. This is especially good advice when the tissue to be injected is dense and inelastic. Rather inject too little than too large an amount.

4. *After Treatment.*—If the injection has been made into loose tissue, the paraffin must be kept quiet and free from pressure, otherwise it may migrate into the surrounding structures. Under such circumstances, iced cloths may be applied to the region in an effort to make the paraffin set more rapidly. Sometimes there may be

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for, perhaps, the first twelve hours after the operation a marked disturbance in the local circulation, as is evidenced by great redness and swelling and, more rarely,

Figure 2.

pain in the tissues about the eyes and nose. This transitory reaction may also be relieved by the application of cold compresses.

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Paget gives his patients a hand glass as soon as they come out from under the general anesthetic and allows them to mold the nose at that time.

After the first twelve hours the swelling, the redness and the pain rapidly diminish, if they have not already gone, and, as a general rule, no further treatment is required.

REPORT OF CASES.

CASE 1.—Mrs. F., American, widow, aged 42. When a small child was struck in the face with a sharp ax, which resulted in a severe injury to the nose, the nasal bones were broken and followed by a necrosis, which caused a loss of the entire septum, a depression of the nasal bridge and collapse of one nostril.

Examination revealed on a profile view (Fig. 2): 1. A typical saddle-back nose. The extent of this depression, or sinking in of the bridge of the nose, was about one-sixteenth of an inch below the normal line of the nose, the greatest depression being situated at about the junction of the nasal bones with the lateral cartilages of the nose. 2. The tip of the nose was forced upward; this feature was exaggerated by the depression immediately above it. 3. A still more unsightly deformity consisted of a ridge or strip of flesh extending from about the junction of the middle with the superior third of the upper lip to the internal aspect of the tip of the nose. The attachment of this strip at the labial extremity was considerably below the cleavage of the lip and the nose proper, in consequence of this low origin daylight could be seen between the superior margin of this strip and the inferior margin of the nose proper. This artificial column was about half an inch in diameter at the labial insertion, and from that tapered down to about a quarter of an inch at the nasal end.

This objectionable strip of tissue was the result of a previous operation, the object of which was to supply the nose with an artificial column, and so to divide the single anterior nares into two, and in this way decrease to some extent, at least, the deformity. In this operation a flap was dissected from the median line of the upper lip, turned on itself and attached to the internal surface of the tip of the nose. This flap healed in place nicely, but it was too large and bulky at the lip, and was attached to the lip at a point too low down, so allowing a space between the new column and the inferior margin of the nose proper.

This operative procedure for the formation of a new columna nasi was first described by John B. Roberts, in the Mutter Lecture of the College of Physicians of Philadelphia, 1900,

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entitled "The Surgical Treatment of Congenital and Pathologic Disfigurements of the Face." (*Phil. Med. Jour.*, June 23, 1900, p. 1425.) Yet, despite such a prominent publication and as an example of the disregard of American writings by some of the European writers, we find in the *Medizinskoie Obozrenie*, Vol. lviii, No. 15, an article by P. I. Kusmin, entitled "A New Method of Correcting the Destroyed Nasal Septum," which is practically the same method as has been recommended by Roberts and employed in this case.

Figure 3.

In this instance the result is unsatisfactory, in that the base of the flap took its origin too far away from the junction of the nose and the lip. This fault was corrected by subsequent operations, but as no paraffin was injected they will not be considered under this title.

On a front view of the face (Fig. 3) the most noticeable departure from the usual was a collapse of the left nostril. That portion of the nose usually held in proper position by

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the inferior lateral cartilages was flattened and almost in contact with the median line. There being no septum the interference with respiration, especially inspiration, was not marked. The patient usually wore a metal, aluminum, intranasal support, in this way almost correctly remedying the defect. The wearing of this support was irritating, annoying and objectionable. The new column was very prominent and bulky at its origin from the upper lip, and appeared as a reddish bunch on the lip. The depression in the bridge of the nose was not so noticeable as in the profile view. The tip of the nose seemed to be tilted upward and the anterior nares seemed to present in an anterior inferior direction, instead of in an inferior direction, as they should normally. On an intranasal examination, there was noted most prominently the absence of a septum. The mucosa lining the cavity appeared to be normal.

The patient came requesting that her nose be improved on; that the artificial septum be raised at its labial extremity so that it might appear continuous with the nose on profile; that the sinking in of the left ala might be remedied so that it would not be necessary for her to wear the intranasal support, and that the depression in the bridge of the nose might be rendered less conspicuous, if not removed.

All these conditions were in time corrected, but, in accordance with the title, this paper will deal only with a consideration of those operations in which paraffin was injected as a prosthetic measure.

Operation 4, Injection 1.—A typical operation for the repair of a saddle-back nose: Cocain, 1 per cent. solution, was employed as the anesthetic. The needle was made to enter the skin at a point near the tip of the nose, and about twenty drops of the paraffin were injected. There was no pain during or soon after the operation; the next day and the day following there was noted a sense of fulness and some uneasiness, but at no time was there any complaint of sensation coming under the heading of pain, in its proper sense.

The second day after the operation there was noticed a slight redness of the skin over the injected paraffin, this increased for about a day and was then pronouncedly red.

This redness remained stationary for about a month, and since then has very gradually decreased, so gradually, in fact, that there is still a distinct reddened area over the bridge of the nose. On pressure this redness will disappear, but returns immediately after the removal of the pressure. A few dilated and tortuous capillaries course their way over this area. The condition is still present fourteen months after the injection. There has been practically no change or decrease in the redness during the last six or seven months, it is not as marked as it was during the first few months, but still re-

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quires the profuse application of face powder in order to prevent her nose from being conspicuously red.

There is absolutely no pain, tenderness or abnormal sensa-

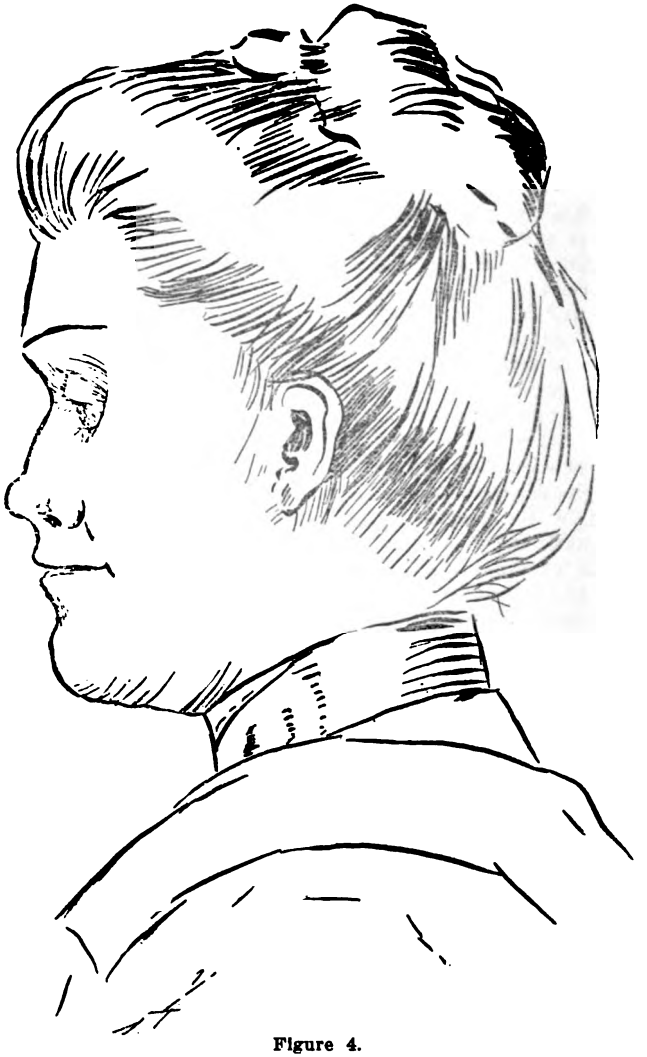

Figure 4.

tion over the injected portion, or any other portion of the nose or face. With the exception of the redness the operation is quite satisfactory in its outcome, both to patient and

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surgeon; another small injection is needed to make the result perfect (Fig. 4). The obliteration of the dilated blood vessels by means of electricity or by crucial incision of the skin is now under consideration.

Operation 6, Injection 2.—A second injection was made in the same case two months after the first in an attempt to remedy the collapse or flattening of the right wing of the nose. In reviewing the literature on this subject, very meager as it is, no practical method with anything but a remote promise of success seemed to present itself.

Roe advocates in such cases that we incise the lower shield cartilage, and sometimes the upper shield cartilage also, sufficiently to overcome their elasticity, and then to hold the alæ, with their incised cartilages, in the more expanded position, until repair takes place, and the tissues are fixed in their new shape and form. He also recites a case in which the cartilage is dissected subcutaneously and "reset" in its proper, or at least in a better, location.

Such maneuvers in this case were out of the question, as there was no cartilaginous tissue in the ala of the nose on the right side.

The more radical method advocated by Fritz Koenig (*Berl. Klin. Woch.*, Feb. 17, 1902) of replacing the abnormal or diseased ala by a portion of the entire structure of the auricle and suturing this in place on the nose, seemed a trifle too radical for any condition in which there was not an absence of the ala. But no other method of replacing the missing cartilage seemed available. At this time the idea of producing artificial cartilage presented itself and was grasped as a most satisfactory solution to the rather trying problem.

Accordingly the ala was injected with paraffin as follows: After a careful and proper cleansing of the skin and mucous membrane of the nose a preliminary anesthesia, Schleich's solution No. 1, was injected into the site of the proposed paraffin injections. After a lapse of about twenty minutes the needle of the syringe containing the paraffin was inserted into the free edge of the ala at a point about half way between the tip of the nose and the cheek. The needle was made to penetrate about three-eighths of an inch, and then about six drops were injected. The needle was withdrawn and the puncture sealed with collodion.

The needle was now introduced at a point three-quarters of an inch above the free border of the ala, in about the center of the lateral aspect of the nose from above downward, for a distance of about a quarter of an inch, and the same amount of paraffin injected.

The intranasal support was now introduced and held the parts in approximately normal relations, iced cloths were ap-

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plied for twelve hours and the intranasal support allowed to remain in place for ten days.

There was absolutely no pain or inconvenience caused by the injection, and the course of the case was uneventful. There is considerable improvement in the appearance of the nose, but it is not as perfect as it is when the ala is held in proper position by the intranasal support (Fig. 4). The result, while not perfect, was such as to make considerable of an improvement in the countenance and expression of the patient. In a case less complicated, with more substance to act as a foundation, as in congenital deformities, it is probable that a still more satisfactory outcome could be obtained. Unfortunately

Figure 5.

Figure 6.

the writer has never seen a similar case treated by any other method, and so is unable to draw any comparative conclusions. Parker reports one case treated in this manner, but with no improvement after repeated injections.

Case 2.—Tim M., miner, Irish, aged 28, in a rough and tumble fight was unfortunate enough to have the tip of his nose bitten off by his opponent. He presented himself, ten hours after the accident, at the St. Vincent's Hospital, with the separated portion of his nose wrapped up in a piece of newspaper, and requested that it be sewed in place. Wet dressings were applied to the abbreviated feature and in due time flaps from the cheek were brought over and the defect covered

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up. The result was satisfactory in covering the defect with skin, but the configuration of the nose was far from satisfactory, owing to the absence of the tip. The front view was not so unusual or remarkable, but the profile presented a marked and conspicuous deformity in the absence of the tip; in fact, the distal third of the appendage was missing (Fig. 5).

This was, in a way, remedied, or rather rendered less noticeable by the introduction of paraffin into the region formerly

Figure 7.

occupied by the extremity of the nose. After the usual cleansing and the regular preparations, about ten minims of paraffin were injected under the flap and in about the median line, so that it would rest on the remains of the cartilaginous septum.

After a month this procedure was repeated, without any undesirable result after either injection (Fig. 6). The improvement was encouraging and the skin over the injected mass normal in every particular and not at all tense or stretched. Other injections were planned, but the patient disappeared.

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The introduction of small amounts, at intervals, is undoubtedly to be preferred to the single injection of larger amounts, in any location and under all circumstances, but it is especially true and important when injecting into a region so notoriously non-vascular and

Figure 8.

prone to necrosis as the tip of the nose. And of still greater importance is this precaution when the overlying skin of this part has been transplanted from a neighboring region.

Case 3.—Dick G., laborer, American, aged 37, about eleven years ago fell down a stairway and injured his nose. No physician was called to see him, and he paid little or no at-

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tention to the injury; he merely remembers that for about a week or so his nose was tender and his entire face swollen. After the swelling subsided he noted a depression in the bridge of his nose (Fig. 7.), which has remained about the same ever since. It caused him no pain or inconvenience other than the slight deformity. The skin over the depression is normal and moves freely over the cartilage and bone.

A typical operation for "sadle-back" nose was performed, technic as described above; fifteen minims were injected at one sitting. The result was a marked improvement in his appearance and was very satisfactory. No redness of the skin over the injected area or any other objectionable features resulted (Fig. 8).

Figure 9.

Figure 10.

Case 4.—Mr. W. E., miner, American, aged 32, three years ago, while in a fist fight, was struck on the nose. He had considerable nose bleed, pain and marked swelling the next morning, at which time he consulted a physician, who told him that his nose was broken, and then proceeded to "set" it. After the swelling had subsided a depression of the bridge was noted, which has remained practically the same ever since (Fig. 9). The greatest depression is at about the junction of the nasal bones with the cartilages and in depth is about one-sixteenth of an inch. The skin and overlying structures are normal and freely movable. Treatment consisted of a sub-

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cutaneous injection of paraffin, the same as in the case above, about twenty-five minims were injected at one sitting, and the result was eminently satisfactory in every respect (Fig. 10).

CONCLUSIONS.

1. Corning was the first to use solidifying oils in surgery.

2. Gersuny was the first to recommend and to use paraffin subcutaneously as a prosthetic measure.

3. The use of paraffin as a prosthetic substance is still in an experimental stage.

4. The field of usefulness of paraffin subcutaneously in other than nasal deformities is rapidly increasing.

5. Prosthetic operations, undertaken solely for cosmetic effect, should be absolutely harmless.

6. All cases, regardless of the termination, should be reported, as it is only by a study of a large number of cases that the legitimate place of this method in surgery can be ascertained.

7. The special syringe, with screw pressure, is almost indispensable.

8. A general anesthetic is rarely, if ever, indicated.

9. The needle may be made to enter at either the base or the tip of the nose.

10. Rather inject too little than too large an amount of paraffin.

11. In a series of six cases, but one of the numerous objections was encountered, and that a redness of the skin remaining permanently after the injection.

DISCUSSION.

DR. ANDREW W. MORTON, San Francisco—My experience with paraffin injections has been limited to 25 cases. My method is somewhat different from Dr. Connell's. I bring the melting point of the paraffin to 109 degrees by the use of sperm oil, after which it is sterilized by boiling. I am careful to introduce it just as it is beginning to coagulate. It has been proven thoroughly by Dr. Comstock that we must have the paraffin about the temperature of the blood to prevent embolism; it is also well to have the paraffin a little above the temperature of the blood or it will not support the deformity. For the introduction of the paraffin I have been

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using the Lures glass syringe. I always introduce the needle at some distance from the deformity beneath the skin, allowing the point of the needle to come just beneath the deformity, then I attach the filled syringe and introduce the paraffin.

It has been used in a great variety of cases, but the principal use, in my opinion, is for the saddle-back deformities of the nose. We know there is no class of deformities where we have need of repair more than in those cases. On account of the weakness of the structures, if we use an artificial bridge it is always causing irritation and operations are not satisfactory. In regard to the quantity of the paraffin, I always use a small quantity and repeat it if necessary, but I think this is very immaterial if we do not produce tension, and I think Gersuny has called attention to that; his experience has shown that the amount injected at one time does not make any material difference. I have introduced 40 c.c. at one time; it was in the case of an absent testicle; the man wished to enter the marine-hospital service, but had been rejected. I injected the 40 c.c. at one time, and there was absolutely no change so far as inflammation was concerned, and the day he went away I could not discern which was the artificial testicle except by palpation.

There is one subject that has not been touched on, and that is, what becomes of the paraffin? It was claimed that it could not be absorbed, and would remain in the tissues as paraffin. Recently I had a case which enabled me to make some very interesting experiments. Some of the paraffin had worked down into the tissues and interfered with the breathing space. I took out sections at the end of one, two, three and four months respectively. In the first section you will see paraffin globules; later you will notice that they have been infiltrated with leucocytes and tissue cells. In the last specimen you see an entire absence of the paraffin. This shows that the paraffin is destroyed and its place is taken by connective tissue. In regard to the shrinking of the paraffin, I believe that it will shrink to a slight degree, owing to the small amount of oil which passes off after the injection. As to the principal dangers of the operation, they are: 1, infection; 2, tissue necrosis, or necrosis of the bone; 3, embolism. The infection can be prevented by being aseptic. It is also possible to prevent sloughing, provided you do not use your paraffin at an extreme degree of heat, or produce a great amount of tension on the skin. In regard to embolism, one case of lung embolism has been reported that we attributed to this method. A large amount of paraffin was used, the operation being done in the physician's office for some prolapsed condition of the rectum, and the patient was allowed to enter a carriage and ride home —not a very cautious thing to do. One of the principal points is not mentioned in the report, the melting point of the

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paraffin. I do not believe that there is very much danger of embolism if we use the paraffin at a melting point above the body heat.

Dr. John P. Lord, Omaha—Dr. Connell speaks of the disadvantages of the reddened area. I want to say that our experience with the *x*-ray in the blanching of unsightly red scars has been so satisfactory that I have perfect confidence in it, and the technic should be that the exposure should be of short duration and the treatment should cover a long period of time, care being exercised not to produce a burn. The *x*-ray obliterates the small blood vessels by producing an hyperplasia of the connective tissue cells which squeeze out the blood vessels. Of course, if the blood vessels are of any size I would recommend the use of the electrolytic needle, but if it is simply a redness I think the *x*-ray can be depended on to accomplish very satisfactory results.

Dr. William J. Mayo, Rochester, Minn.—The methods employed for the repair of depressed noses may be divided into three groups: first, those by a flap from the forehead or cheek or the tip of the little finger, and things of that kind carried to the nasal defect, the best result being that after we got through most people would say that it did not look much worse than it did before. In the second class we introduce a celluloid bridge. Some exceedingly good results have been obtained, but after a time atrophy necrosis takes place in the majority of cases, and we have to remove the celluloid. Therefore, when this paraffin method came out it was taken up enthusiastically, particularly by my brother, Dr. C. H. Mayo, who has had considerable experience in this line of work. He has operated on a large number of cases and the results have been strikingly good. You see the patient come into the hospital with a deformed nose, and in twenty minutes he goes out again, his appearance so changed that his best friends would scarcely recognize him. In regard to those cases in which the deformity is due to a compound injury, if you were to attempt to inject enough of the paraffin to get a good result you would be very liable to get into trouble, on account of the adhesions of the skin to the deeper parts. In those cases a small knife is introduced and the tissue cut loose a few days previous to the injection; the paraffin can then be injected without trouble. It is advisable in some cases, where you have to sever the tissue in this manner, to use an injection of saline solution to loosen the tissues still further, and follow this in a few days by the injection of paraffin.

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EXECUTIVE SESSION

TUESDAY, MAY 5—AFTERNOON.

The meeting was called to order at 2 p. m. by the Chairman, James E. Moore, Minneapolis.

The Chairman's address, entitled "A Plea for Exploratory Operations," was read.

H. J. Whitacre, Cincinnati, read a paper entitled "Suppression of Urine; Report of a Case Enduring Eight Days, Relieved by Decapsulation of the Kidneys."

J. R. Guthrie, Dubuque, Iowa, read a paper entitled "Fat Necrosis of the Kidney."

Alex. Hugh Ferguson, Chicago, read a paper entitled "The Surgical Treatment of Nephritis."

The Chairman then introduced Dr. Adolph Lorenz of Vienna, who spoke as follows: "I do not intend to impose on your kindness. As far as I know, some ten or fifteen minutes are accorded to every speaker. I will only take one or two minutes, just to thank you for your welcome and to wish a courteous success to the members of the Section."

The papers previously read were then discussed by the following: Arthur Dean Bevan, Chicago; Jepson, Iowa; McLaren, Minnesota; R. H. Gibbons, Scranton, Pa.; Ramon Guiteras, New York; McArthur, Chicago; F. A. Dunsmoor, Minneapolis; Winslow, Baltimore, and Whitacre and Ferguson.

B. B. Davis, Omaha, read a paper entitled "Indications for Cholecystectomy."

F. A. Dunsmoor, Minneapolis, read a paper entitled "The Call for Exploratory Operation in the Gall Bladder Region."

These papers were discussed by W. J. Mayo, Rochester, Minn.; J. B. Murphy, Chicago; A. J. Ochsner, Chicago; Hamilton, Columbus, Ohio; Richard H. Gibbons, Scranton, Pa., and Davis and Dunsmoor.

James B. Bullitt, Louisville, Ky., moved that the Executive Committee be appointed the Nominating Committee, which motion was duly seconded and carried, and the Secretary instructed to cast the ballot therefor.

WEDNESDAY, MAY 6—MORNING.

The meeting was called to order at 9:30 a. m. by the Chairman.

Van Buren Knott, Sioux City, Iowa, read a paper entitled "A Contribution to the Surgery of Gastric Ulcer."

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H. D. Niles, Salt Lake City, read a paper entitled "Surgical Conception of Pyloric Obstruction."

A. J. Ochsner, Chicago, read a paper entitled "Clinical Observations in Stomach Surgery."

These papers were discussed by A. H. Andrews, Chicago; W. J. Mayo, Rochester, Minn.; Carl Wagner, Chicago; William L. Rodman, Philadelphia; A. H. Cordier, Kansas City; Arthur Dean Bevan, Chicago; and Knott, Niles and Ochsner.

O. Beverly Campbell, St. Joseph, Mo., read a paper entitled "The Single Cuff Method of Circular Enterorrhaphy; A New Method."

James H. Dunn, Minneapolis, read a paper entitled "Intestinal Resection, with Report of Fifteen Cases, Nine with the Button and Six with the Suture."

These papers were discussed by Jonas, Omaha; Horsely, Texas; Walker, Detroit; J. B. Murphy, Chicago; Alex. Hugh Ferguson, Chicago, and Campbell.

Arthur Dean Bevan of Chicago made the following motion: "That the Delegates of the Section on Surgery call the attention of the House of Delegates to the fact that much surgical work, such as appendicitis, gastric ulcer, typhoid perforation and gall-bladder surgery, is being at the present time duplicated in two Sections of this Association, and that the very important work of obstetrics is not being sufficiently emphasized. I move that it is the sense of the Section on Surgery that its interests would be best conserved if the surgical diseases of women were transferred to the Section on Surgery, leaving to the gynecologic section obstetrics and the diseases of the genital organs of women. I move that the Delegates of the Section on Surgery bring this matter before the House of Delegates." This motion was duly seconded and carried.

WEDNESDAY, MAY 6—AFTERNOON.

John T. Bottomley, Boston, read a paper entitled "Multiple Osteomyelitis."

Edward H. Nichols, Boston, read a paper entitled "Osteomyelitis."

These papers were discussed by DeForest Willard, Philadelphia; J. C. Stewart, Minneapolis; J. B. Murphy, Chicago; Richard Gibbons, Scranton, Pa., and Nichols.

John A. Wyeth, New York, read a paper entitled "The Treatment of Vascular Tumors by the Injection of Water at a High Temperature, with Suggestions as to Its Employment in Tubercular Adenitis, Abscess, Fistulous Tracts, etc." This paper was discussed by W. J. Mayo, Rochester, Minn.; John P. Lord, Omaha; Richard H. Gibbons, Scranton, Pa., and Wyeth.

William J. Mayo, Rochester, Minn., read a paper entitled "Further Experience with the Vertical Overlapping Method for

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the Radical Cure of Umbilical Hernia." This paper was discussed by A. J. Ochsner, Chicago; J. B. Murphy, Chicago; Wather, Louisville; Magee, Minnesota; Alex. Hugh Ferguson, Chicago, and W. J. Mayo.

W. T. Eckley, Chicago, read a paper entitled "Evolution of the Mammalian Straight Gut, with Special Reference to Peritoneal Changes Incident to Rotation." This paper was discussed by Willis, California, and Richard H. Gibbons, Scranton, Pa.

Fred. B. Lund, Boston, read a paper entitled "The Value of Enterostomy in Selected Cases of Peritonitis." This paper was discussed by Tinker, Baltimore; Miles F. Porter, Fort Wayne, Ind.; Thomas, Washington; James B. Bullitt, Louisville, Ky.; F. A. Dunsmoor, Minneapolis, and F. B. Lund.

F. D. Smythe, Memphis, Tenn., read a paper entitled "Cholecystectomy versus Cholecystorrhaphy and Cholecystostomy." No discussion.

Richard H. Gibbons, Scranton, Pa., read a paper entitled "Dangers Attendant on Attempt at Gaining the Period of Interval in Operation for Appendicitis." This paper was discussed by H. D. Niles, Salt Lake City; James B. Bullitt, Louisville, Ky.; A. J. Ochsner, Chicago; W. J. Mayo, Rochester, Minn.; J. B. Murphy, Chicago, and R. H. Gibbons.

THURSDAY, MAY 7—MORNING.

The meeting was called to order at 9:30 a. m. by the Chairman.

DeForest Willard, Philadelphia, read a paper entitled "Sunshine and Fresh Air versus Roentgen and Finsen Rays in the Treatment of Tuberculosis of Bones and Joints."

J. Clark Stewart, Minneapolis, read a paper entitled "Epithelioma Under the *X*-Ray; a Preliminary Report of the Histologic Changes."

These papers were discussed by Henry A. Christian, Boston; Edward H. Nichols, Boston; Ridlon, Chicago; Fred. B. Lund, Boston; Browden, Clarksville; James E. Thompson, Galveston, Texas, and Willard and Stewart.

John E. Summers, Jr., Omaha, read a paper entitled "Varix of the Inferior Mesenteric Vein Complicated by Chronic Ulcerative Colitis; Operation." This paper was discussed by F. D. Smythe, Memphis; Milliken, Texas, and Summers.

Charles A. Powers, Denver, read a paper entitled "Congenital Dislocation of the Radius." This paper was discussed by John T. Bottomley; Fred. B. Lund, Boston; DeForest Willard, Philadelphia, and Powers.

John P. Lord, Omaha, read a paper entitled "Acute Epiphysitis of the Head of the Femur, Causing a Condition Subsequently Simulating Congenital Misplacement." This paper was discussed by Ridlon, Chicago; Townsend, New York, and Lord.

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THURSDAY, MAY 7—AFTERNOON.

The meeting was called to order at 2 p. m. by the Chairman.

The Nominating Committee reported the following nominations: Chairman, Charles A. Powers, Denver; secretary, E. Wyllys Andrews, Chicago; delegate, William J. Mayo, Rochester, Minn.

On motion, duly made, seconded and carried, the Secretary was instructed to cast the ballot for these candidates, and they were unanimously elected.

W. H. Earles, Milwaukee, read a paper entitled "Necessity for More Care in the Treatment of Skull Fractures." This paper was discussed by Sherrill, Louisville, Ky.; Carl Wagner and Sullivan, Chicago; B. B. Davis, Omaha; Brown, Alabama; Lemmon, Milwaukee; Witherspoon, Illinois, and Earles.

James B. Bullitt, Louisville, Ky., read a paper entitled "Epispadias; Report of a Case Treated by a Modification of Cantwell's Method." This paper was discussed by Poorham, Martin and Fenner, New Orleans, and Bullitt.

Charles A. Powers, the chairman-elect, was then introduced by the Chairman and made the following remarks:

Mr. Chairman and Gentlemen: To be elected the presiding officer over this large body of American surgeons is to me a great honor. To be the successor, as Chairman of this Section, of Murphy, Rodman, Ochsner, Walker, Mayo, Moore and DeForest Willard is to me very much of a compliment. However unworthy I am, however undeserving of this tribute I may be, I promise to serve you faithfully and to the very best of my ability.

Rudolph Matas, New Orleans, read a paper entitled "Cicatricial Ankylosis of the Jaws; a Contribution to Its Operative Treatment." This paper was discussed by J. B. Murphy, Chicago; Eastman, Indiana; Martin, New Orleans; A. J. Ochsner, Chicago, and R. Matas.

Arthur Dean Bevan, Chicago, read a paper entitled "Further Contribution to the Surgery of Undescended Testicle." This paper was discussed by W. T. Eckley and Carl Wagner, Chicago; Bartlett, St. Louis; A. J. Ochsner, Chicago; Rodman, Philadelphia, and Bevan.

J. B. Murphy, Chicago, read a paper entitled "Surgery of the Urinary Tract in the Female, Experimental and Clinical." This paper was discussed by McLaren, St. Paul; Goodhue, Ohio; Hart, Chicago; Taggert, Chicago; F. D. Smythe, Memphis; M. B. Tinker, Baltimore, and Murphy.

A. H. Levings, Milwaukee, read a paper entitled "Consideration of Mammary Cysts in the Early Diagnosis of Breast Tumors." This paper was discussed by B. B. Davis, Omaha; Sullivan, Chicago; Knight, Hartford, Conn.; Morton, California, and Levings.

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FRIDAY, MAY 8—MORNING.

The meeting was called to order at 9 a. m.

Dr. Sexton read a paper entitled "Treatment of Fractures of the Femur in Plaster-of-Paris Casts." This paper was discussed by John P. Lord, Omaha; Grant, Denver; Brandon, Tennessee; Andrews, Mankato; Maurey, New York; Crouse and Sexton.

Miles F. Porter, Fort Wayne, Ind., read a paper entitled "The Closure of Wounds." This paper was discussed by John E. Summers, Jr., Omaha; Pearse, Kansas City; Morton, California; Perkins, New Orleans, and Porter.

T. C. Witherspoon, St. Louis, read a paper entitled "Operative Treatment of Exophthalmic Goiter." This paper was discussed by Grant, Denver; Rixford, California; Horsely, Texas, and Witherspoon.

F. G. Connell, Leadville, Colo., read a paper entitled "Subcutaneous Injections of Paraffin for Deformities of the Nose." This paper was discussed by Morton, California, and John P. Lord, Omaha.

Walter M. Spear, Rockland, Me., read a paper entitled "Abscess of the Spleen." No discussion.

E. J. Mellish, El Paso, Texas, read a paper entitled "Anesthesia." This paper was discussed by James E. Moore, Minneapolis; A. J. Ochsner, Chicago; M. B. Tinker, Baltimore; William J. Mayo, Rochester, Minn.; John E. Summers, Jr., Omaha, and Mellish.

On motion of John P. Lord, Omaha, duly seconded and carried, the following papers were read by title: "Indications and Technic of Nephrectomy," Ramon Guiteras, New York; "Contributions to the Therapy of Surgical and Other Diseases with *X*-Rays," Rudolph Matas, New Orleans; "The Surgical Treatment of Ascites Due to Cirrhosis of the Liver," M. L. Harris, Chicago.

A. J. Ochsner, Chicago, moved that this Section extend its most hearty thanks to Dr. Moore, our President, and Dr. Munro, our Secretary, for having arranged one of the finest programs that has even been before any surgical section and for having carried out the conduct of this meeting in a most masterly and successful way. This motion was unanimously carried.

Final adjournment.

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